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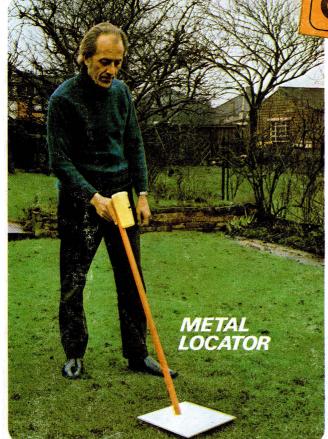
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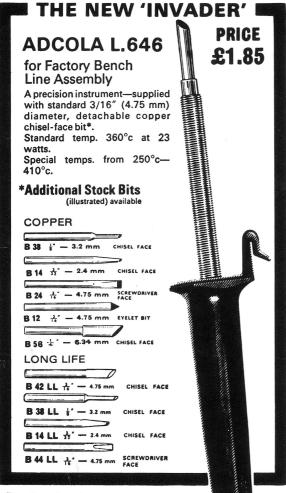








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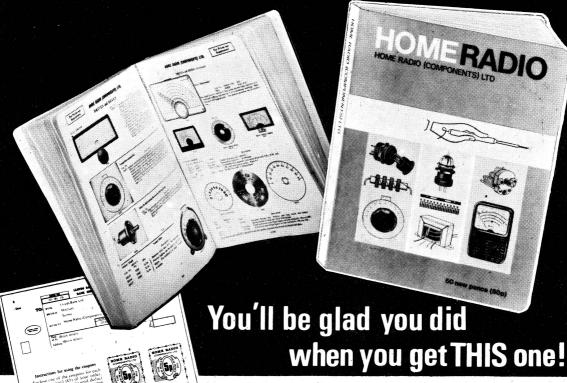
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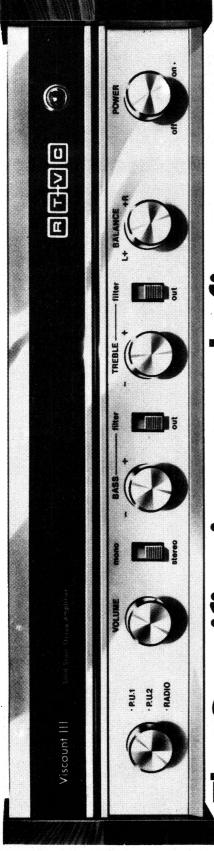
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The exclusive Duo loudspeaker systems

designed 3 systems and the heart of them all is the Viscount III amplifier. A unit of great eye appeal with teak finished cabinet. It is available in 2 versions — RIO0 for ceramic cartridges, and RIO1 for magnetic and ceramic. FET's (Field effect transistors) like top priced units. FET's give you more of the signal you want and almost none of the hiss you don't. Both units have output sockets for headphones and tape recorder. Filters and tone controls give a wide range incorporated on the input stages, just

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£22.00+90p p&p £14.00+£2 p&p Viscount III R101 amplifier £ 2 × Duo Type II speakers £ Garrard SP25 Mk. III with MAG. PRICES SYSTEM I

€59.00 Available complete Total

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power 20 watts at 3 ohms. Freq. range 20Hz to 20kHz. Teak veneer cabinet. £32 pair +£3 p&p.

with parasitic tweeter. Max. power 10 warts,

3 ohms. Simulated Teak cabinet.

£14 pair+£2 p&p.

£23.00+£1.50

cartridge plinth and cover

р&р

Size approx. 17" \times 10 $\frac{2}{3}$ " \times 6 $\frac{2}{3}$ ". Drive unit 13" \times 8"

SPEAKERS Duo Type II

for only £52+£3.50 p&p

£22.00+90p p&p £32.00+£3 p&p £23.00+£1.50 00.773 2 × Duo Type III speakers Garrard SP25 Mk. III with MAG. cartridge, plinth and cover SYSTEM 2 Viscount R101 amplifier

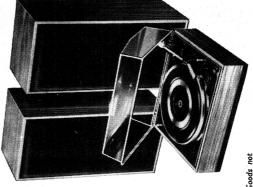
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SYSTEM 3
Viscount II Amplifier R100 £17.00+90p p&p 2 × Duo Type II speakers, pair £14.00+£2 p&p Garrard SP25 Mk. III with CER. £21.00+£1.50 and cover

> substantial cabinets. There's a choice of the Duo Il's for the smaller room or the big are incomparable for quality within their price range. Large speakers in extremely Duo III's for real bass response.

SPECIFICATION R101

If watts per channel into 3 to 4 ohms. Total distortion @ 10W @ 1kHz 0-1%. P.U.1 (for ceramic carridges) 150mV into 3 Meg. P.U.2 (for magnetic carridges) HW @ 1kHz into 4fK. equalised within ± 1dB R.I.A.A. Radio 150mV into 220K. (Sensitivities given at full power). Tape out facilities: headphone socket, power out 250mV per clinites: headphone socket, power out 250mV per channel. Tone controls and filter characteristics. Bass: +12dB to — 174B @ 60Hz. Bass filter: 64B per occave cut.
Treble control: treble + 124B to — 124B @ 18KHz.
Treble filter: 124B per octave. Signal to noise ratio:
(all controls at max) R10H—P.U.1 and ratio—554B.
P.U.2 — 584B. R106 same as R101 but P.U.2 (for crystal cartridges) 450mV into 3 Meg. Cross talk better than — 354B on all inputs. Overfload characteristics better than — 354B on all inputs. Overfload characteristics better than — 354B on all inputs. Size approx



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AFI25	19p	OC28 OC35	48p
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AF179	66p	OC72	120
AFI80	45p	OC75	20p
AF239 BC107	32p	OC200 OC201	27p
BC107	iib	OCP71	38p 60p
BC109 BC147	Ϊĺρ	STI40	15p
BC 147	12p	ST141	23p
BC148	12p 12p	UT46 2N696	35p 15p
BC149 BC157	15p	2N706A	120
BC158	14p	2N2926G	14p
BC159 BD131	14p 75p	2N2926Y 2N2926O	13p
BD132	75p	2N2926U 2N3053	12p 25p
BFI15	25p	2N3054	60p
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BF185 BF194	32p 14p	2N3706	14p
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Anti-surge 20mm—5p
80, 125, 200, 315, 400, 500, 630, 800mA; 1, 2 amp.

PANEL FUSEHOLDERS

For Ilin fuses For 20mm fuses

CONTROLS, Log. or Lin. Single, less switch, 15p Single, D.P. switch, 24p Tandem, less switch, 40p $5k\Omega$, $10k\Omega$, $25k\Omega$, $50k\Omega$, $100k\Omega$, $250k\Omega$, $500k\Omega$, $100k\Omega$, $250k\Omega$, $500k\Omega$, $100k\Omega$,

RESISTORS

Carbon
All 5%, high-stability, El2 values.
½W, I‡p; IW, 4p; 2W, 6p Wire-wound 5W, 10p; 10W, 12p

ELEC	TRO	LYTIC	cs		
1μF 2μF 4μF 8μF	450V 500V 350V 450V	19p 20p 14p 16p	1,000μF 1,000μF 2,000μF 2,000μF	25 V 50 V 25 V 50 V	27p 39p 36p 53p
16μF 25μF 32μF 50μF	450V 50V 450V 50V	17p 8p 24p 10p	2,500µF 2,500µF 3,000µF 5,000µF	25V 50V 25V 25V	45p 60p 48p 55p
100μF 100μF 250μF 250μF	25V 50V 25V 50V 25V	10p 10p 12p 17p	5,000μF 8-8μF 8-16μF 16-16μF	50V 450V 450V 450V 450V	98p 18p 20p 27p
500μF 500μF	50V	18p 25p	16-32μF 32-32μF 50-50μF	450V 450V 350V	63p 49p 38p

MINIATURE FLECTROLYTICS

*****	~			
lμF	25V	IOμF	64V	
2.5µF	64V	I6μF	40V	_
4µF	40V	25µF	25V	7
5μF	64V	30µF	15V	
8µF	157	50μF	150	
8µF	40V	100µF	150	•
10μF	150			_

ALUMINIUM BOXES with lids and screws

Type	Length	Width	Depth Price	e
GB7*	2∄in	5 <u></u> ∔in	l∔in 38₁	D
GB8*	4in	4in	1-∮in 38 j	Þ
G B9*	4in	2 ∦ in	l∯in 38 i	Þ
GBI0*	4in	5 <u>∔</u> in	1-jin 44 i	
GBII	4in	2-jin	Žin 38 j	Þ
GB12	3in	Žin	lin 33	
GB13	6in	4in	2in 52 j	P
GB14	7in	· 5in	2∳in 63 j	
GB15	8in	6in	3in 81	P
GB16	l Oin	7in	3in 92 i	p
*	These sizes	fit standard	Veroboards	

VEROBOARD

Size	0·I matrix	0-15 matrix
2∳in × 3∦in	22p	16p
2-∮in × 5in	24p	25p
3∄in × 3∄in	24p	25p
3∯rin × Šin	27p	29p
l7in × 2- <u>‡</u> in	75p	57p
l7in × 3≩in	£I	75p
Pins—both s	sizes; packet	of 36, 18p

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Transistor equivalent book, BPI, 40p

LOW-OHM RESISTORS

 $2\frac{1}{2}$ watt wire-wound. 1Ω , 1.8Ω , 2.7Ω , 3.3Ω , 3.9Ω , 4.7Ω , 5.6Ω , 6.8Ω , 8.2Ω



CAPA	CITO	RS		0·0027μF 0· 003 μF	500V 500V	S/M Cer.	15p 5p
2-2pF	500V	S/M	7 <u>‡</u> p	0 0033μF	1250	P.S.	6p
3-3pF	500V	S/M	7∳P 7∳P	0.0033µF	500∨	Poly.	6p
5pF	500V	S/M	7 <u>}</u> p	0 0033μF	1,000∨	MDC	6р
10pF	125V 500V	P.S. S/M	-5p	0·0036μF	500V	S/M	15p
10pF 15pF	1257	P.S.	71p 5p	0 0047μF 0 0047μF	125V 500V	P.S. Poly.	9p 6p
15pF	500V	Cer.	4p	0.0047µF	500V	S/M	20p
18pF	500 V	S/M	7 1 P	0.0047µF	1.0000	MDC	6p
22pF	125V	P.S.	5p	0 005μF	1000	Mylar	3p
22pF	500V	S/M	7‡p	0 005μF	500∨	Cer.	5p
25pF 27pF	500V	S/M	7 p	0 0068μF	125V 500V	P.S. S/M	10 1 p
33pF	500V 125V	Cer. P.S.	4p 5p	0·0068μF 0·0068μF	500V	Poly.	30p 6p
33pF	500V	s/M	74n	0.0082μF	1257	P.S	101p
39pF	500V	S/M	71P 71P	0.0082µF	500V	P.S. S/M	30p
47pF	125V	P.S.	5p	0.01 µF	127	Disc	4p
47 p.F	500V	Cer.	_4p	0 0 I μF	125V	P.S.	10 1 p
50pF	500∨ 500∨	S/M S/M	7.1P	0.01μF	160V 250V	Poly.	4p
56pF 68pF	1257	P.S.	71p	0·01μF 0·01μF	400V	M.F. Poly.	3p 3p
68pF	500V	S/M	5p 71p	0 0 ΙμF	500V	Cer.	5p
75pF	500V	S/M	71p	0.01μF	500V	S/M	30p
82pF	500V	S/M	7 P 7 P	0 01μF	600V	MDC	7p
100pF	125V	P.S.	5p	0 0 I μF	1,000V	MDC	9p
100pF 100pF	500∨ 500∨	S/M Cer.	7ip	0·015μF 0·015μF	160V 400V	Poly.	3p
120pF	500 V	S/M	5p 7∮p	0.013μF 0.02μF	1007	Poly. Mylar	3p 3p
150pF	125V	P.S.	. 3p	0.022uF	180	Disc	5p
150pF	500V	S/M	7 1 p	0·022μF 0·022μF	250V	M.F.	3р
150pF	500V	Cer.	5p	0·022µF	400V	Poly.	3р
180pF 200pF	500∨ 500∨	S/M S/M	71P 71P	0·022μF 0·022μF	600V	MDC MDC	71p 9p
220pF	1257	P.S.	′1P 5p	0·022μF 0·033μF	1,000V 250V	M.F.	7P 4p
220pF	500V	Cer.	Sp.	0 033μF	400V	Poly.	4p
250pF	500∨	S/M	8p	0·047μF	127	Disc	6p
270pF	500V	Cer.	5p	0·047μF	160V	Poly.	3p
300pF	500V 125V	S/M	8p	0·047μF	250V	M.F.	3p
330pF 330pF	500V	P.S. S/M	5p 8p	0·047μF 0·047μF	400∨ 600∨	Poly. MDC	4p 8p
390pF	500V	S/M	8p	0·047μF	1.0007	MDC	10p
470pF	125V	P.S.	5p	0·1μF	30V	Disc	6p
470pF	750∨	Disc	5p	0·1μF	250∨	M.F.	4p
500pF	500V	S/M	8p	0 Ιμ Ε	400V	Poly.	5p
560pF 680pF	500V 125V	S/M P.S.	8p 6p	0·1μF 0·1μF	1,000V	MDC	10p 13p
680pF	500V	S/M	8p	0·1μF 0·15μF	250	M.F.	5p
820pF	500V	S/M S/M	8p	0·22μF	160V	Poly.	6p
0 00 I μF	100∨	Mylar	3p	0 22μF	250V	M.F.	5p
0 00 I μF	125V	P.S.	6p	0·22μF	400V	Foil	10p
0·001μF	400V	Poly. S/M	3p	0 22μF	1,000V	MDC	15p
0·001μF 0·001μF	500∨ 500∨	Cer.	10p 5p	0·33μF 0·47μF	250V 250V	M.F. Foil	8p 8p
0.001 µF	1,000V	MDC	6p	0·47μF	400V	Foil	15p
0·0015μF	400V	Poly.	3p	0·47μF	1,000V	MDC	20p
0 00 I 5μF	500V	S/M	10p	I OμF	250V	M.F.	15p
0.0015μF	500V	Cer.	.5p	NI			
0·0018μF 0·002μF	500V	S/M Mylar	10p 3p	Note:	lver mics	10/ 10	1
0.002µF	500V	Cer.	5p	P.S. = po	lver mica olystyren	e 24%	tol.
0·0022μF 0·0022μF	125V	P.S. S/M	6р	MDC	a.c. ratın	g = 300	٧.
0·0022μF	500∨	S/M	10p	M.F. = P	1ullard m	nin. foil	
0·0022µF	1,000∨	MDC	6р	Cer. = c	eramic.		

0.0027µF

500V S/M

PLUGS

PLUGS
Car aerial
Co-axial
D.I.N. 2 pin (speaker)
D.I.N. 3 pin
D.I.N. 4 pin
D.I.N. 5 pin, 180
D.I.N. 5 pin, 240°
D.I.N. 6 pin
Jack, 2½mm unscreened
Jack, 3½mm unscreened
Jack, 3½mm screened
Jack, ½in screened
Jack, ½in screened
Jack, ½in screened
Jack, ½in screened Jack, stereo, unscreened Jack, stereo, unscreened Jack, stereo, screened Phono, platic top Phono, plated metal Phono, fitted 4 ft lead Wander, red or black Banana 4mm, red or black

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Co-axial
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D.I.N. 3 pin
D.I.N. 5 pin, 180
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Lab. 31 mm Jack, 3½mm Jack, ½in screened Jack, stereo, screened Phono, plated metal



SOCKETS

Car aerial
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Co-axial, flush
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D.I.N. 3 pin
D.I.N. 5 pin, 180°
D.I.N. 5 pin, 240° D.I.N. 5 pin, 240°
Jack, 2 pim
Jack, 3 pim
Jack, 3 pim
Jack, 4 in unswitched
Jack, 4 in switched
Jack, tereo, switched
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Phono, 3 on a strip
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ı	Amstrad IC2000	£27 ·	
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1	Alpha Highgate 212	£25	
1	Alpha Highgate FA300	£31	
ı	Alpha Highgate FA400 Cambridge P100	£116	
ı	Cambridge P40	£65	
ı	Cambridge P50	£71	
ı	Ferrograph F307 Mk. II	~	•••
ŧ	(Wood cased)	£47	. 50
ı	Ferrograph F307 Mk. II		
ı	(Metal cased)	£45	
ı	Leak Delta 30	£48	
1	Leak Delta 70	£56	
ı	Metrosound ST20E	£24	
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ı	Rogers R/bourne (Chassis)	£41	
1	Rogers R/bourne (Cased)	£46	.50
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ı	Sinclair PRO60 2 x Z30/PZ6	£17	.50
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1	Z50/PZ8/Trans	£21	
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١	Sinclair 605	£18	
ı	Sinclair 2000 Mk. II Sinclair 3000 Mk. II	£21	
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١	Sugden A21/11	£102	
ı	Sugden A51/C51 Wharfedale Linton	£102	
1	Goodmans Max Amp	£37	
1	Teleton SAQ206B	£21	
Į	Teleton SAO306B	£22	
1	Europhon 10 + 10	£16	



TUNERS

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Armstrong 524	£31 · 00
Rogers Ravensbrook FET	4
(Chassis)	£31 · 00
Rogers Ravensbrook FET	4
(Cased)	£35·00
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(Chassis)	£43 · 00
Rogers Ravensbourne FE	T4
(Cased)	£48 · 00
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Leak Delta FM (Cased)	£55·50
Leak Delta AM/FM (Case	d) £66·50
TUNER/AMPLII	EIEDC
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I OHEK/API EIT	I O I I EIVAIN EINENS				
Please add 75p for P. & P	.				
Alpha Highgate 150	£44.95				
Alpha Highgate R500	£64 · 50				
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Philips RH702	£82 · 50				
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Rogers R/brook (Chassis)	674 50				

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Wharfedale Dovedale 3	£61 · 50
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AC176			15p	BF180	85p	NKT125	40p	OC206	90p	2N1711	15p
AC187 25p BF194 17p NKT212 25p ORP60 40p 2N2368 17p AC188 25p BF194 17p NKT212 25p ORP60 40p 2N2368 17p ACY18 20p BF196 15p NKT213 25p ORP60 40p 2N2368 17p ACY18 20p BF196 15p NKT218 25p ORP60 40p 2N2368 17p ACY21 20p BF200 35p NKT216 25p ST140 15p 2N2369 A 19p ACY20 20p BFX13 25p NKT216 25p ST140 15p 2N2369 A 19p ACY21 19p BFX29 25p NKT218 25p ST140 15p 2N2369 A 19p ACY21 19p BFX29 25p NKT218 25p NT141 20p 2N2369 A 45p ACY21 15p BFX85 25p NKT218 25p NT141 20p 2N2369 A 45p ACY40 15p BFX85 25p NKT212 27p T1P31A ACY40 15p BFX85 25p NKT217 18p T1P32A 74p 2N2369 A 45p ACY41 15p BFX85 25p NKT272 17p T188A 45p NKT271 AD140 55p BFX85 25p NKT272 17p T188A 45p NKT273 20p UL914 40p 2N2268 all AD149 55p BFX85 25p NKT272 27p UL914 40p 2N2268 all AD149 35p BFY51 19p NKT281 29p UL923 40p Colours 10p AF116 25p BFX93 17p NKT281 29p V405A 45p 2N3064 55p AF116 25p BFX93 17p NKT281 29p AF116 25p BFX93 17p NKT281 29p ZTX302 13p 2N3056 60p AF116 25p BFX93 16p NKT315 25p ZTX302 13p 2N3056 60p AF116 25p BFX93 16p NKT315 25p ZTX303 13p 2N3056 60p AF116 25p BFX93 16p NKT315 25p ZTX304 27p 2N3704 11p AF118 40p BFX22 20p OA47 8p ZTX303 13p 2N3705 10p AF116 25p BFX93 16p NKT315 25p ZTX304 27p 2N3704 11p AF186 40p BFX92 25p OA47 8p ZTX303 13p 2N3705 10p AF116 40p BFX23 20p OA47 8p ZTX303 13p 2N3705 10p AF126 17p BFX92 25p OA47 8p ZTX303 13p 2N3705 10p AF126 40p BFX92 25p BFX92 25p OA47 8p ZTX304 27p 2N3704 11p AF186 40p BFX100 15p OA37 8p ZTX500 16p 2N3708 9p AF279 47p BFX10 15p OA39 8p ZTX500 16p 2N3708 9p AF279 47p BFX10 15p OA39 8p ZTX500 16p 2N3708 9p AF279 47p BFX10 15p OA39 8p ZTX500 16p 2N3708 9p AF279 47p BFX10 15p OA39 8p ZTX500 16p 2N3708 9p AF279 47p BFX10 15p OA39 8p ZTX500 16p 2N3708 9p AF279 47p BFX10 15p OA39 8p ZTX500 16p 2N3708 9p AF279 47p BFX10 15p OA39 8p ZTX500 16p 2N3708 9p AF279 47p BFX10 15p OA39 8p ZTX500 16p 2N3708 9p AF279 47p BFX10 15p OA39 8p ZTX500 16p 2N3708 9p AF279 47p BFX10 15p OA39 8p ZTX500 16p 2N3708 9p AF279 47p BFX10 15p OA39 8p ZTX500 16p 2N3708 9p AF279 47p BFX10 15p OA39 8p ZTX500 16p 2N3708 9p AF2			19p	BF181	85p		37p	OC207	75p	2N2147	75p
AC188 25p BF195 15p NKT212 25p ORP60 40p 2N2368 17p ACV17 27p BF195 15p NKT216 46p P346A 10p 2N2369 17p ACV18 20p BF200 35p NKT216 46p P346A 10p 2N2369 17p ACV18 20p BF200 35p NKT216 46p P346A 10p 2N2369 17p ACV19 20p BF200 35p NKT216 46p P346A 10p 2N2369 17p ACV20 20p BF200 35p NKT216 46p P346A 10p 2N2369 17p ACV20 20p BFX18 25p NKT216 25p ST140 15p BFX29 25p NKT218 25p ST140 15p BFX29 25p NKT218 25p ST141 20p 2N2904A 48p ACV40 10p BFX85 34p NKT217 5p T1783A 74p 2N2905A 75p ACV41 15p BFX85 34p NKT271 8p T1782A 74p 2N2905A 75p ACV41 15p BFX85 34p NKT271 8p T1782A 74p 2N2905A 75p ACV41 15p BFX85 25p NKT272 17p T188A 45p 2N2905 AF5 ACV41 15p BFX85 25p NKT272 17p T188A 45p 2N2905 AF5 ACV41 15p BFX85 25p NKT272 17p T188A 45p 2N2906 AF5 ACV41 15p BFX85 25p NKT272 17p T188A 45p 2N2906 AF5 ACV41 15p BFX85 25p NKT272 20p U1923 40p 2N29906 AF5 ACV41 25p BFX85 27p NKT278 20p U1923 40p 2N29906 AF5 ACV41 25p BFX85 27p NKT278 20p U1923 40p 2N29906 AF5 ACV41 25p BFY85 20p NKT282 25p NKT280			Zop Obn	DF184	2Up		20p	OPPIO	50n	2N2148	67n
ACY17 27p BF195 15p NKT213 25p ORP61 40p 2N2369 AP ACY19 20p BF200 35p NKT216 25p ST140 15p 2N2369 AP ACY21 19p BFX31 25p NKT218 25p ST140 15p 2N2369 AP ACY21 19p BFX32 25p NKT218 25p ST140 15p 2N2369 AP ACY21 19p BFX34 25p NKT218 25p ST140 15p 2N2369 AP ACY21 10p BFX34 25p NKT218 25p ST140 15p 2N2369 AP ACY21 15p BFX34 25p NKT218 25p ST141 25p 2N2369 AP ACY40 15p BFX35 34p NKT271 18p TIP32A ACY40 15p BFX36 25p NKT219 17p TIP31A AD ACY40 15p BFX36 25p NKT272 27p TIP31A AD ACY40 15p BFX36 25p NKT272 17p TIR38A AP DEVELOPE AP ACY40 15p BFX36 25p NKT274 15p TIP32A ACY40 15p BFX36 30p NKT274 15p UL900 40p 2N2360 44p AD 149 50p BFX38 34p NKT271 18p TIP32A AD 140 55p BFX36 30p NKT274 15p UL900 40p 2N2360 44p AD 149 2N2326 all action and action act			25p	BF104	20p	NKT919		ORPEO	40n	2N2100	17p
ACY18 20p BF200 35p NKT217 50p SL403D 31-50 X2046 47p ACY19 20p BF201 35p NKT218 25p SL403D 31-50 X2046 47p ACY20 20p BFX18 25p NKT218 25p ST140 15p SC20 X204 49p ACY21 10p BFX29 25p NKT218 25p ST141 20p N2904A 49p ACY41 15p BFX29 25p NKT218 25p ST141 20p N2904A 49p ACY40 15p BFX85 34p NKT217 52p T1F31A ACY41 15p BFX85 34p NKT217 15p T1F32A ACY41 15p BFX85 34p NKT271 15p T1F32A AD140 55p BFX87 30p NKT272 17p T1F38A 45p N2906A 45p AD140 55p BFX87 30p NKT272 17p T1F38A 45p N2906A 45p AD140 50p BFX85 24p NKT273 20p UL914 40p N29906A 54p AD140 50p BFX85 24p NKT273 20p UL923 40p C2000000 12p AD162 36p BFY50 22p NKT282 20p X7406 40p N29906A 54p AD140 24p BFY92 20p NKT284 20p X7406 40p N29906A 54p AP106 24p BFY92 20p NKT284 50p ZTXX00 15p NS055 60p AF116 25p SFX19 10p NKT284 50p ZTXX00 15p NS055 60p AF116 25p SFX19 10p NKT284 50p ZTXX00 15p NS055 60p AF116 25p SFX19 10p NKT284 50p ZTXX00 15p NS055 60p AF116 25p SFX19 10p NKT284 50p ZTXX00 15p NS055 60p AF116 25p SFX19 10p NKT284 50p ZTXX00 15p NS055 60p AF116 25p SFX19 10p NKT284 50p ZTXX00 15p NS055 60p AF116 25p SFX19 10p NKT284 50p ZTXX00 15p NS055 60p AF116 25p SFX19 10p NKT284 50p ZTXX00 15p NS055 60p AF116 25p SFX19 10p NKT284 50p ZTXX00 15p NS055 60p AF116 25p SFX19 10p NKT284 50p ZTXX00 15p NS055 60p AF116 25p SFX19 10p NKT284 50p ZTXX00 15p NS055 60p AF116 25p SFX19 10p NKT284 50p ZTXX00 15p NS055 60p AF116 25p SFX19 10p NKT284 50p ZTXX00 15p NS055 60p AF116 25p SFX19 10p NKT284 50p ZTXX00 15p NS055 60p AF116 25p NS055 60p AF116			27n	BF195	15p		25p		40n	2N2369	17n
ACY19 20p BFX13 25p NKT217 50p SL408D £1-50 2N2646 44p ACY21 19p BFX29 25p NKT218 25p NKT218 25p ST140 15p 2N2904 44p ACY21 10p BFX84 25p NKT218 25p T141 20p 2N2904A 46p ACY21 10p BFX84 25p NKT219 25p T1781A 20p 2N2904A 46p ACY21 15p BFX86 25p NKT217 18p T1782A 74p 2N2905A 75p ACY41 15p BFX86 25p NKT272 17p T188AA 45p 2N2905 45p ACY41 15p BFX86 25p NKT272 17p T188AA 45p 2N2906A 45p AD149 50p BFX87 30p NKT274 18p UL900 40p 2N2906A 45p AD149 50p BFX88 24p NKT275 20p UL914 40p 2N2926 all colours 10p AD161 36p BFY51 19p NKT281 29p V406A 45p 2N2905 all colours 10p AD161 25p BFY51 19p NKT281 29p V406A 45p 2N2905 all and 16p AD161 25p BFX91 16p NKT281 29p AP166 24p BFY52 20p NKT278 16p AD161 25p BFX91 16p NKT31 25p ZTX302 13p 2N305 60p AF116 25p BFX91 16p NKT31 25p ZTX302 13p 2N305 60p AF116 25p BFX91 16p NKT31 25p ZTX302 13p 2N305 60p AF116 25p BFX91 16p NKT31 25p ZTX304 27p 2N3702 10p AF118 44p BFX21 20p AA 2 DA162 20p ZTX314 11p 2N3705 10p AF128 47p BFX92 25p AA 2 DA162 20p ZTX314 11p 2N3705 10p AF128 40p BFY92 25p AA 2 DA162 20p ZTX314 11p 2N3705 10p AF128 40p BFY92 20p AA 2 DA162 20p ZTX314 11p 2N3705 10p AF128 40p BFY92 20p AA 2 DA162 20p ZTX314 11p 2N3705 10p AF128 40p BFY92 20p AA 2 DA162 20p ZTX314 11p 2N3705 10p AF128 40p BFY92 20p AA 2 DA162 20p ZTX314 11p 2N3705 10p AF128 40p BFY92 20p AA 2 DA162 20p ZTX314 11p 2N3705 10p AF128 40p BFY92 20p AA 2 DA162 20p ZTX314 11p 2N3705 10p AF128 40p BFY92 20p AA 2 DA162 20p ZTX314 11p 2N3705 10p AF128 40p BFY92 20p AA 2 DA162 20p ZTX314 11p 2N3705 10p AF128 40p BFY92 20p AA 2 DA162 20p ZTX314 11p 2N3705 10p AF128 40p BFY92 20p AA 2 DA162 20p ZTX314 11p 2N3705 10p AF128 40p BFY92 20p AA 2 DA162 20p ZTX314 11p 2N3705 10p AF128 40p BFY92 20p AA 2 DA162 20p ZTX314 11p 2N3705 10p AF128 40p BFY92 20p AA 2 DA162 20p ZTX314 11p 2N3705 10p AF128 20p A			20p		15p		46p	P346A	19p	2N2369A	19p
ACY20 200 BFX13 25p NKT218 25p ST140 15p 2N2904 44p ACY21 10p BFX85 25p NKT212 25p ST141 20p 2N2904A 45p ACY40 15p BFX85 34p NKT271 32p TTP31A 62p 2N2905 A 75p ACY40 15p BFX85 34p NKT271 17p TTS88A 45p 2N2905 A 75p ACY41 15p BFX85 34p NKT271 17p TTS88A 45p 2N2906 A 75p ACY41 15p BFX85 34p NKT271 17p TTS88A 45p 2N2906 A 75p ACY41 15p BFX85 25p NKT272 17p TTS88A 45p 2N2906 A 54p AD140 50p BFX85 25p NKT274 12p UL991 40p 2N2906 A 54p AD140 50p BFX85 24p NKT275 20p UL914 40p 2N2906 A 54p AD161 25p BFY50 22p NKT278 20p UL914 40p 2N2906 A 54p AD161 25p BFY50 22p NKT280 27x 10x 11p 2N3906 A 54p AD161 25p BFY50 27p NKT403 65p ZTX108 11p 2N3906 32p 2N3905 AP116 25p BFY90 67p NKT403 65p ZTX108 11p 2N3906 32p 2N3905 AP116 25p BFY90 67p NKT403 65p ZTX108 11p 2N3906 32p AP116 25p BFX90 67p NKT403 65p ZTX108 11p 2N3906 32p AP116 25p BFX90 67p NKT403 65p ZTX300 13p 2N3905 60p AP116 25p BFX90 67p NKT403 65p ZTX300 13p 2N3905 10p AF117 25p BSX20 16p NKT451 58p ZTX300 13p 2N3905 10p AF117 25p BSX20 16p NKT452 54p ZTX300 13p 2N3905 10p AF117 25p BSX20 16p NKT452 54p ZTX300 13p 2N3905 10p AF118 44p BSX21 20p OA5 20p ZTX300 31p 2N3902 10p AF118 44p BSX21 20p OA5 20p ZTX300 31p 2N3902 10p AF118 25p BFY90 40p AN 4P128 45p BSX20 20p OA40 8p ZTX300 31p 2N3906 9p AF129 10p OA35 8p ZTX500 30p 2N3906 9p AF129 10p OA35 8p ZTX500 30p 2N3900 9p AF129 10p OA35 8p ZTX500 30p 2N3900 9p AF129 10p OA35 8p ZTX500 20p 2N3910 9p AF129 20p OA50 8p ZTX500 10p 2N390 9p AF129 10p OA50 8p ZTX500 10p 2N390 9p AF129 20p OA50 8p ZTX500 10p 2N390 9p AF129 2N4906 10p C473 15p OC22 47p 2N5756 9p ZN390			20p		35p		50p	SL403D	£1.50	2N2646	47p
ACY21 19p BFX29 25p NKT219 25p ST141 20p 2N2904A 49p ACY22 10p BFX84 25p NKT223 27p TIPS1A ACY40 15p BFX85 25p NKT271 18p TIPS2A 74p 2N2905A 74p ACY41 15p BFX85 25p NKT271 18p TIPS2A 74p 2N2905A 74p ACY41 15p BFX85 25p NKT272 17p TIRS8A 45p X2806 44p ACY41 15p BFX85 25p NKT272 12p UL990 45p 2N2906A 45p ACY41 15p BFX85 24p NKT275 20p UL914 40p X2926A 44p ACY41 14p ACY42 14p X2926A 14p X2926A 14p ACY42 14p X2926A 14p ACY42 14p X2926A 14p ACY42 14p ACY42 14p X2926A 14p ACY42 14p X2926A 14p ACY42 14p AC		ACY20	20p	BFX13	25p	NKT218	25p	ST140	15p	2N2904	44p
ACY42 10p BFX85 34p NKT271 8p TIPS2A 7p Z0p 10p ACY41 15p BFX85 34p NKT271 8p TIPS2A 7d 2N2905A 75p ACY41 15p BFX85 34p NKT271 17p TIRS8A 4bp 2N2905A 35p ACY41 15p BFX85 34p NKT272 17p TIRS8A 4bp 2N2905A 35p ACY41 15p BFX87 30p NKT274 12p TIRS8A 4bp 2N2905A 35p ACY41 35p BFX87 30p NKT274 2p UU5914 4bp 2N2906A 54p AD161 36p BFY86 22p NKT276 20p UU5914 4bp 2N2906A 54p AD161 36p BFY86 22p NKT276 20p UU5914 4bp 2N2906A 54p AD162 36p BFY86 22p NKT278 20p UU5914 4bp 2N2906A 54p AD162 36p BFY86 22p NKT286 2p V406A 46p 2N3803 20p AF116 22p BFY80 37p NKT403 65p ZTX108 11p 2N3064 56p AF116 22p BFY80 37p NKT403 65p ZTX108 11p 2N3064 56p AF116 22p BFY80 37p NKT403 65p ZTX108 13p 2N3055 60p AF114 22p BFX80 12p NKT415 18p ZTX300 13p 2N3055 60p AF117 22p BFX80 12p NKT415 18p ZTX300 13p 2N3056 10p AF116 22p BFX80 12p NKT415 2p ZTX300 13p 2N3056 10p AF116 2p BFX80 12p NKT415 2p ZTX300 13p 2N3056 10p NKT416 2p BFX80 12p NKT415 2p ZTX300 13p 2N3056 10p AF116 2p BFX80 12p NKT415 2p ZTX300 13p 2N3056 10p AF116 2p BFX80 12p NKT415 2p ZTX300 13p 2N3056 10p AF116 2p BFX80 12p NKT415 2p ZTX300 13p 2N3056 10p AF116 2p BFX80 12p NKT415 2p ZTX300 13p 2N3056 10p AF116 2p BFX80 12p NKT415 2p ZTX300 13p 2N3056 10p AF116 2p BFX80 12p NKT415 2p ZTX300 13p 2N3056 10p AF116 2p BFX80 12p NKT415 2p ZTX300 13p 2N3056 10p AF116 2p BFX80 12p NKT415 2p ZTX300 13p 2N3056 10p AF116 2p BFX80 12p NKT415 2p ZTX300 13p 2N3056 10p AF116 2p BFX80 12p NKT415 2p ZTX300 13p 2N3056 10p AF116 2p BFX80 12p NKT415 2p ZTX300 13p 2N3056 10p AF116 2p BFX80 12p NKT415 2p ZTX300 13p 2N3056 10p AF116 2p BFX80 12p NKT415 2p ZTX300 12p 2N3064 11p AF116 2p BFX80 2p ZTX300 12p ZTX300 13p 2N3056 10p AF116 2p BFX80 2p BFX80 2p BFX80 2p ZTX300 12p ZTX300 13p 2N3706 12p 2N3706		ACY21	19p	BFX29	25p	NKT219	25p	ST141	20p	2N2904A	. 49p
AD140 55p BFX87 30p NKT274 18p U1900 40p 2N2906A 54p AD140 50p BFX88 24p NKT275 20p U1914 40p 2N2906A 54p AD161 36p BFY86 22p NKT278A 12p U1923 40p 2N2906A 36p BFY86 22p NKT278A 12p U1923 40p 2N2906A 36p BFY86 22p NKT278A 12p U1923 40p 2N2926 all AP166 24p BFY82 20p NKT28A 22p X7X108 11p 2N3054 56p AP114 25p BFY82 20p NKT28A 22p Z7X108 11p 2N3054 56p AP114 25p BFY96 67p NKT486 60p Z7X300 13p 2N3055 60p AP116 25p BFY90 67p NKT486 60p Z7X300 13p 2N3055 60p AP116 25p BFY90 67p NKT486 50p Z7X300 13p 2N3054 56p AP116 25p BFY90 67p NKT486 50p Z7X300 13p 2N3054 56p AP116 25p BFX90 67p NKT486 50p Z7X300 13p 2N3054 56p AP116 25p BFX90 16p NKT455 54p Z7X300 13p 2N3054 56p AP116 25p BFX90 16p NKT455 54p Z7X300 13p 2N3054 56p AP116 25p BFX90 16p NKT455 54p Z7X300 13p 2N3054 11p AP118 44p BFX21 20p OA5 20p Z7X341 11p 2N3056 10p AP118 44p BFX21 20p OA5 20p Z7X340 31p 2N3706 9p AP128 30p BFX95A 12p OA10 25p Z7X300 30p 2N3706 9p AP128 30p BFX95A 12p OA10 25p Z7X300 30p 2N3706 9p AP128 30p BFX95A 12p OA10 25p Z7X300 30p 2N3706 9p AP128 30p BFX95A 12p OA10 25p Z7X300 30p 2N3706 9p AP239 30p ZX300 30p ZX300 30p ZX300 40p ZX300			10p	BFX84	25p	NKT223	27p		62p	2N2905	65p
AD140 55p BFX88 24p NKT275 29p UL914 AD161 36p BFY56 19p NKT278 12p UL923 40p NC2026 all Colours 10p NC2036 14p NC2036 14					34p	NKT271	18p	TIP32A	74p	2N2905A	. 75p
AD1619 50p BFX58 22p NKT279A 12p UL923 40p Colores 10p AD162 36p BFY56 22p NKT278A 12p UL923 40p Colores 10p AD162 36p BFY56 22p NKT28B 22p V406A 45p 2N3063 20p AF106 24p BFY62 20p NKT28B 22p V406A 45p 2N3063 20p AF116 22p BFY96 67p NKT403 65p ZTX108 11p 2N3064 56p AF116 22p BFY96 67p NKT403 65p ZTX108 11p 2N3064 56p AF116 22p BFY96 67p NKT403 65p ZTX308 13p 2N3055 60p AF116 22p BFX96 17p NKT404 60p ZTX300 13p 2N3055 60p AF116 22p BFX96 17p NKT404 60p ZTX300 13p 2N3056 10p AF116 22p BFX96 12p AF126 24p ZTX300 13p 2N3056 10p AF116 22p BFX96 12p AF126 24p ZTX308 13p 2N3702 10p AF117 22p BFX96 12p AF126 24p ZTX308 13p 2N3702 10p AF117 22p BFX96 12p AF126 24p ZTX308 13p 2N3702 10p AF126 24p ZTX308 12p ZTX308 1			15p	BFX86	25p	NKT272	17p	T1888A	45p	2N2806	44p
AD16161 369 BFY561 19p NKT281 29p V406A 46p X3033 20p AP166 24p BFY52 20p NKT403 65p ZTX308 11p ZN3054 56p AP116 25p BFY561 75p NKT404 60p ZTX300 13p X3055 66p AP115 25p BFY59 67p NKT405 58p ZTX302 13p X3055 66p AP115 25p BSX19 16p NKT415 58p ZTX302 13p X3055 66p AP116 25p BSX19 16p NKT415 58p ZTX302 13p ZN3702 10p AP117 25p BSX29 16p NKT415 25p ZTX304 27p ZN3703 10p AP117 25p BSX29 16p NKT415 25p ZTX304 27p ZN3703 10p AP118 44p BSX21 20p OA5 20p ZTX314 11p X3703 10p AP118 44p BSX21 20p OA6 20p ZTX314 11p X3703 10p AP126 17p BSY29 25p OA47 8p ZTX303 45p X3703 10p AP126 40p X100 15p OA73 8p ZTX300 18p X3703 10p AP128 40p X301 00 AA7 8p ZTX300 18p X3703 10p AP128 40p X301 00 AA7 8p ZTX300 18p X3703 10p AP128 40p X301 00 AA7 8p ZTX300 15p X3703 10p AP128 40p X310 15p OA73 8p ZTX500 16p X3703 71p AP128 AP128 40p X310 15p OA33 8p ZTX500 16p X3703 71p AP128 AP128 30p BY127 15p OA73 8p ZTX500 16p X3703 71p AP128 AP129 30p X311 20p OA5 8p ZTX500 17p X3711 9p AP129 30p X311 20p OA5 8p ZTX500 17p X3711 9p AP129 30p X311 20p OA5 8p ZTX500 17p X3711 9p AP129 30p X313 20p OA5 8p ZTX500 17p X3711 9p AP129 30p X313 20p OA5 8p ZTX500 17p X3711 9p AP129 30p X313 20p OA5 8p ZTX500 17p X3811 9p X3812 30p X33 15p OA80 8p IN914 7p X3828 30p X373 15p OA202 10p IN4603 12p X3866 12p AP129 10p C447 15p OA202 10p IN4603 10p X3466 12p AP129 AP			50p	BFX87	30p		18b		40p	2N2906A	. 54p
AP102 39p BFY02 20p NKT281 29p V400A 49p 2NS083 20p AF114 25p BFY05 17p NKT403 65p ZTX300 13p 2NS055 60p AF114 25p BFY09 67p NKT403 65p ZTX300 13p 2NS055 60p AF116 25p BFY09 67p NKT404 60p ZTX300 13p 2NS055 60p AF116 25p BFY09 67p NKT404 60p ZTX300 13p 2NS055 60p AF116 25p BFX09 67p NKT405 54p ZTX300 13p 2NS055 60p AF116 25p BSX29 16p NKT452 54p ZTX300 13p 2NS702 10p AF116 25p BSX29 16p NKT452 54p ZTX303 13p 2NS702 10p AF116 25p BSX29 16p NKT452 54p ZTX303 13p 2NS703 10p AF116 25p BSX29 16p NKT452 54p ZTX303 13p 2NS703 10p AF116 25p BSX29 16p NKT452 54p ZTX303 13p 2NS703 10p AF116 25p BSX29 15p OA5 25p ZTX303 13p 2NS704 11p AF116 25p BSX29 15p OA5 25p ZTX303 15p 2NS704 11p AF116 25p BSX29 15p OA7 25p ZTX303 15p 2NS704 11p AF116 25p BSX29 15p OA7 25p ZTX300 16p 2NS706 15p AF116 40p AF11		AD149	36p	BEV50	24p		20p		40p		311 10m
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AP118 44p BSX21 20p OA10 25p ZTX320 30p ZN3705 10p AP126 17p BSY29 25p OA47 8p ZTX330 30p ZN3705 10p AP126 17p BSY29 25p OA47 8p ZTX330 30p ZN3707 11p AP186 40p BY100 15p OA70 8p ZTX350 10p ZN3707 11p AP186 40p BY100 15p OA70 8p ZTX500 10p ZN3708 7p AP186 40p BY100 15p OA70 8p ZTX500 10p ZN3708 7p AP186 40p BY100 15p OA70 8p ZTX500 10p ZN3708 7p AP289 30p BY127 15p OA90 8p ZTX500 10p ZN3709 8p AP289 30p BY127 15p OA88 8p ZTX500 20p ZN3710 9p ASY20 25p BYZ12 30p OA86 8p ZTX500 40p ZN3711 9p ASY20 25p BYZ12 30p OA86 8p ZTX500 40p ZN3711 9p ASY20 25p BYZ12 30p OA86 8p ZTX500 40p ZN3811 9p ASY20 25p BYZ12 30p OA86 8p ZTX500 40p ZN381 9p ASY20 35p C3V8 15p OA90 10p IN4000 10p ZN3820 30p ASY20 35p C3V8 15p OA90 10p IN4000 10p ZN3820 30p BC108 10p C4V3 15p OA90 10p IN4000 10p ZN4060 12p BC108 10p C4V3 15p OC20 47p IN4006 12p ZN4082 15p BC108 10p C5V1 15p OC22 47p ZN5756 95p ZN4082 15p BC148 10p C5V1 15p OC22 47p ZN5756 95p ZN4082 15p BC168 10p C6V2 15p OC24 60p IN4007 20p ZN5245 45p BC168 10p C6V2 15p OC24 60p IN4007 20p ZN5245 45p BC168 10p C6V2 15p OC25 7p ZG302 10p 40309 33p BC168 10p C6V2 15p OC26 35p ZG371 15p 40310 45p BC168 10p C6V2 15p OC26 35p ZG371 15p 40310 45p BC168 10p C6V2 15p OC26 35p ZG374 25p 40310 45p BC168 10p C6V2 15p OC26 35p ZG374 25p 40310 45p BC168 10p C6V2 15p OC26 35p ZG374 25p 40310 45p BC168 10p C6V2 15p OC28 60p ZN174 80p 40300 47p BC168 10p C71 15p OC35 50p ZN355A 50p 40360 43p BC168 10p C8V2 15p OC44 30p ZN35A 50p 40360 43p BC168 10p C71 15p OC35 50p ZN35A 50p 40360 43p BC168 10p C71 15p OC35 50p ZN35A 50p 40360 43p BC168 10p C71 15p OC35 50p ZN35A 50p 40360 43p BC168 10p C71 15p OC35 50p ZN35A 50p 40406 56p BC183 9p C18 15p OC42 30p ZN35A 50p 40406 56p BC183 9p C18 15p OC42 30p ZN35A 50p 40406 56p BC183 9p C18 15p OC42 30p ZN35A 50p 40406 56p BC183 9p C18 15p OC42 30p ZN36A 30p 40406 56p BC183 9p C18 15p OC42 30p ZN36A 30p 40406 56p BC184 13p C16 15p OC42 30p ZN36A 30p 40406 56p BCY30 25p ZN36A 30p CC16 25p ZN36A 30p 40406 56p BCY30 25p ZN36A 30p ZN36A 30p ZN36A 30p 40406 56p BCY30 25p			25n	BSX20	16p		29p	ZTX304	27p	2N3704	
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AF188 30p BS189A 12p OA70 5p Z1X5001 10p Z88708 9p AF289 30p BS127 15p OA70 8p ZTX501 10p Z88708 9p AF279 47p BYZ10 35p OA80 8p ZTX501 10p Z88710 9p AF279 47p BYZ10 35p OA80 8p ZTX502 20p Z88710 9p AF279 47p BYZ10 35p OA80 8p ZTX503 17p Z88711 9p AF270 ASY27 30p BYZ12 30p OA80 8p IN914 7p Z88820 60p ASY28 30p GS33 15p OA80 8p IN914 7p Z88820 60p ASY28 30p GS33 15p OA80 8p IN914 7p Z88820 60p ASY28 30p GS33 15p OA80 8p IN914 7p Z88820 60p ASY28 30p GS33 15p OA80 8p IN940 7p Z88820 30p ASY28 30p GS33 15p OA202 10p IN4603 10p Z84660 12p BC108 10p GS39 15p OA202 10p IN4603 10p Z84660 12p BC108 10p GS39 15p OA202 10p IN4603 10p Z84660 12p BC108 10p GS39 15p OA202 4rp IN4606 12p Z84660 12p BC108 10p GS39 15p OC22 4rp Z87676 95p Z84662 12p BC108 10p GS34 15p OC23 6rp IN4606 12p Z84660 12p BC108 10p GS34 15p OC23 6rp IN4606 12p Z84660 12p BC108 10p GS34 15p OC23 6rp IN4606 12p Z84660 12p BC108 10p GS34 15p OC23 6rp IN4606 12p Z84660 12p BC108 10p GS34 15p OC23 6rp IN4606 12p Z84660 12p BC108 10p GS34 15p OC23 6rp IN4606 12p Z84660 12p BC108 10p GS34 15p OC23 6rp IN4606 12p Z84660 12p BC108 10p GS34 15p OC23 6rp IN4606 12p Z84660 12p BC108 10p GS34 15p OC23 6rp IN4606 12p Z84660 12p BC108 10p GS34 15p OC28 6rp IN4607 20p Z8603 30p BC108 10p GS34 15p OC28 6rp IN4607 20p Z8603 30p BC108 10p GS34 15p OC28 6rp IN4607 20p Z8603 30p BC108 10p GS34 15p OC28 6rp IN4607 20p Z8603 30p BC108 10p GS34 15p OC28 6rp IN4607 20p Z8603 42p BC108 10p GS34 15p OC28 6rp IN4607 20p Z8603 42p BC108 10p GS34 15p OC28 6rp IN4607 20p Z8603 42p BC108 10p GS34 15p OC28 6rp IN4607 20p Z8603 42p BC108 10p GS34 15p OC28 6rp IN4607 20p Z8603 42p BC108 10p GS34 15p OC28 20p Z8606 12p Z8606 42p Z860			17p	BSY29	25p		8p	ZTX330	18p	2N3707	11p
AF239 380 BY127 15p OA79			oup	DOISOA	12p		δD	ZIADUU	16p	2N3708	7p
ASY26 25p BYZ12 30p 0As5 8p ZTX503 17p 2873711 9p ASY27 30p BYZ13 20p 0As5 8p 1N914 7p 287820 60p ASY28 22p BZY88		AF186	40p	BY100	15p		8p	ZTX501	Teb	2N3709	
ASY29 25p BYZ12 30p OA89 8p ZTX504 40p 28819 35p ASY27 30p BYZ13 20p OA89 8p N914 7p 28829 60p ASY28 32p BZY88 OA89 8p N914 7p 28826 30p ASY29 30p C3V3 15p OA89 8p N4002 7p 28826 30p ASY29 30p C3V3 15p OA290 10p N4004 10p 284061 12p BC108 10p C4V3 15p OC22 47p 28756 4pp 184006 12p 284060 12p BC108 10p C4V7 15p OC22 47p 287576 4pp 184006 12p 284062 12p BC148 0p C5V1 15p OC22 47p 287576 4pp 184006 12p 284062 12p BC148 0p C5V1 15p OC23 47p 287576 4pp 184006 12p 284062 12p BC148 0p C6V2 15p OC23 47p 287576 4pp 184006 12p 284062 12p BC148 0p C6V2 15p OC23 47p 287576 4pp 28			47n	DY 127	15p		8p	ZTX 502	170	2N3710	op op
ASY27 30p BYZ13 20p OA90 5p IN914 7p 128820 60p ASY28 22p BZY88			95n	BVZ10	90p		op	ZTY 504	40p		95p
ASY29 22p BZY88	-		200	BV712	905		8n	IN014	777	2113019	
ASIZ23 30p (2373 15p (2472) ASIZ23 37p (2376 15p) (2420 10p (11400) (110p 2)4868 15p (2472) BC107 10p (2379 15p (2422) (10p (14400) (10p 2)4866 112p (2472) (10p			22n	BZV88	Lop		8n	IN4001	70		
ASZ21 37p (23V6 15p 0A200 10p 1N4603 10p 2N4660 12p BC107 10p C3V9 15p 0A200 10p 1N4004 10p N4061 12p BC108 10p (24V3 15p 0C19 37p 1N4006 12p 2N4062 12p BC108 10p C4V7 15p 0C20 47p 1N4006 12p 2N4062 12p BC108 10p C5V1 15p 0C22 47p 2N5756 95p 2N4672 45p BC143 10p C5V1 15p 0C22 47p 2N5756 95p 2N4871 40p N5061 12p BC148 10p C6V2 15p 0C23 40p 1N4007 20p 2N5245 45p BC148 11p C6V8 15p 0C25 37p 2G302 10p 40309 33p BC168 11p C6V8 15p 0C25 37p 2G302 10p 40309 33p BC168 10p C8V2 15p 0C26 33p 2G371 15p 40310 45p BC168 10p C8V2 15p 0C28 40p 2N174 80p 40310 45p BC168 11p C6V1 15p 0C28 40p 2N174 80p 40310 45p BC168 11p C6V1 15p 0C28 40p 2N174 80p 40320 47p BC168 10p C11 15p 0C35 40p 2N1854 50p 40360 43p BC168 10p C11 15p 0C35 40p 2N1854 50p 40360 43p BC168 10p C11 15p 0C35 40p 2N1854 50p 40360 43p BC168 10p C11 15p 0C35 40p 2N1854 50p 40360 43p BC168 10p C11 15p 0C35 40p 2N1854 50p 40360 43p BC168 10p C11 15p 0C35 40p 2N1854 50p 40360 43p BC168 10p C11 15p 0C35 40p 2N1854 50p 40360 43p BC168 10p C11 15p 0C35 40p 2N1854 50p 40360 43p BC168 10p C11 15p 0C35 40p 2N1854 50p 40360 43p BC168 10p C11 15p 0C35 40p 2N1854 50p 40360 43p BC168 10p C11 15p 0C35 40p 2N1854 50p 40360 43p BC168 10p C11 15p 0C35 40p 2N1854 50p 40360 43p BC168 10p C11 15p 0C35 40p 2N1858 50p 40406 56p BC168 10p C12 15p 0C41 20p 2N1858 10p 40406 56p BC168 10p C16 15p 0C41 20p 2N1858 10p 40406 56p BC168 10p C16 15p 0C41 20p 2N1858 10p 40406 56p BC168 10p C16 15p 0C41 20p 2N1858 10p 40406 56p BC183 10p C15 10p 0C75 20p 2N1808 10p 40408 54p BC131 12p C02 15p 0C75 20p 2N1708 10p 40408 54p BC131 12p C02 15p 0C76 20p 2N1711 37p 40407 39p BC132 12p C02 15p 0C76 20p 2N111 37p 40408 55p BC133 45p 0C71 15p 0C72 20p 2N111 37p 40409 55p BC133 40p 0C76 20p 2N111 37p 40409 30p 40408 55p BC133 40p 0C76 20p 2N111 37p 40409 30p 40408 55p BC133 40p 0C76 20p 2N111 37p 40409 30p 40408 30p 2N111 30p 40408 30p 2N111 30p 40408 3		ASY29	30p	C3V3	15p		8p	IN4002	70	2N4058	
BC107 10p (C3Y9 15p OA202 10p IN4004 10p 2N4061 12p BC108 10p C4V7 15p OC20 97p IN4006 15p N4089 15p BC104 10p C5V1 15p OC22 47p IN4006 15p N4289 15p BC144 10p C5V1 15p OC22 47p IN4006 15p N4289 15p BC148 9p C5V6 15p OC22 47p IN4007 20p 2N5245 45p BC148 10p C6V2 15p OC23 60p IN4007 20p 2N5245 45p BC168 11p C6V8 15p OC25 37p 2G302 19p 40309 33p BC167 11p C7V5 15p OC26 33p 2G371 15p 40310 45p BC168 10p C8V2 15p OC28 60p 2G374 25p 40312 48p BC168 11p C8V2 15p OC29 60p 2N174 80p 40326 47p BC168 10p C11 15p OC35 50p 2N385A 50p 40360 43p BC168 10p C11 15p OC35 50p 2N385A 50p 40360 43p BC168 10p C11 15p OC36 63p 2N388A 50p 40366 55p BC183 10p C11 15p OC36 63p 2N388A 50p 40366 55p BC183 10p C11 15p OC42 40p 2N696 15p 40407 33p BC183 10p C15 15p OC44 15p 2N698 30p 40407 33p BC184 13p C16 15p OC45 12p 2N698 30p 40408 51p BC184 12p C16 15p OC45 2p 2N706 10p 40409 54p BC184 12p C22 15p OC72 23p 2N706 10p 40409 54p BCY33 25p C41 15p OC76 23p 2N708 16p 40468A 35p BCY33 25p C41 55p OC76 25p 2N711 37p 40600 58p BCY33 20p CR3/650 45p C076 25p 2N711 37p 40600 54p BCY33 20p CR3/650 45p C071 20p 2N911 20p 40603 49p BCY33 20p CR3/650 45p C071 25p 2N1113 30p 40512 21.45 BCY32 25p 2N113 30p 40576 21.45 BCY32 25.405 MJ480 27p 25.105 MJ480 25p 2N1133 30p 40576 21.45 BCY32 25.405 MJ481 21.25 C0171 30p 2N1306 22p 22		ASZ21	37n	C3V6	15p		10n	IN 4€03	10p	2N4060	12p
BC108 10p (2473 15p)CC19 37p IN4006 12p 2N4062 12p BC104 10p (2571 15p)CC22 47p IN4006 15p 2N4262 15p BC147 10p (2571 15p)CC22 47p IN4006 10p 2N4756 95p 2N4871 40p 2N5756 95p 2N5854 95p			10p	C3V9	15p	OA202	10n	IN4004	10p	2N4061	12n
BC149			10n	C4V3	15p		37p	IN4005	12p	2N4062	12p
BC147 10p (55Y1 15p) C022 47p 2N5756 95p 2N4871 45p BC143 10p (65Y2 15p) C023 40p 1N4007 7 20p 2N5245 45p BC143 10p (65Y2 15p) C025 37p 2G302 10p 40309 33p BC168 11p (67V5 15p) C025 37p 2G302 10p 40309 33p BC168 11p (67V5 15p) C026 33p 2G371 15p 40310 45p 80168 10p (68V2 15p) C028 40p 2N174 80p 40310 45p 80168 10p (68V2 15p) C028 40p 2N174 80p 40320 47p 801692 10p (11 15p) C025 50p 2N385A 50p 40360 43p 801682 10p (11 15p) C035 50p 2N385A 50p 40360 43p 801682 10p (12 15p) C036 63p 2N388A 50p 40360 43p 801682 10p (12 15p) C041 23p 2N404 23p 40382 55p 801682 10p (12 15p) C041 23p 2N404 23p 40362 55p 801682 10p (13 15p) C042 30p 2N698 15p 40406 56p 801682 10p (13 15p) C042 30p 2N698 15p 40406 56p 801682 10p (13 15p) C044 13p 2N698 30p 40406 56p 80182 10p (13 15p) C042 30p 2N698 30p 40408 51p 80141 30p (18 15p) C075 32p 2N706A 10p 40408 51p 80141 30p (18 15p) C075 32p 2N706A 10p 40408 54p 80141 30p (18 15p) C075 32p 2N706A 10p 40408 54p 80141 30p (18 15p) C075 32p 2N710A 30p 40408 54p 80141 30p (18 15p) C075 32p 2N710A 30p 40408 54p 80141 30p 40408 30p 4040			10p		15p		970	IN4006	15p	2N4289	15p
BC148 10p C6V2 15p OC25 7p 2G302 19p 40250 33p BC167 11p (C7V5 15p OC26 33p 2G371 15p 40309 33p BC167 11p (C7V5 15p OC28 60p 2G374 25p 40310 45p BC168 10p C8V2 15p OC28 60p 2N174 80p 40310 45p BC168 10p C6V2 15p OC28 60p 2N174 80p 40320 47p BC168 10p C11 15p OC35 60p 2N174 80p 40320 47p BC168 10p C11 15p OC35 60p 2N355A 50p 40360 43p BC168 10p C11 15p OC36 63p 2N385A 50p 40360 43p BC168 10p C12 15p OC42 30p 2N365A 50p 40360 45p BC168 10p C13 15p OC41 25p 2N404 25p 40362 55p BC168 1 10p C15 15p OC42 30p 2N696 15p 40406 56p BC168 1 10p C15 15p OC44 12p 2N696 15p 40406 56p BC168 1 15p OC44 12p 2N696 15p 40406 56p BC168 1 15p OC44 12p 2N696 10p 40408 51p BC168 1 13p C16 15p OC44 12p 2N696 10p 40408 51p BC168 1 13p C16 15p OC44 12p 2N696 10p 40408 54p BC168 1 13p C16 15p OC44 12p 2N696 10p 40408 54p BC164 1 12p C22 15p OC72 12p 2N706 10p 40408 54p BC121 12p C22 15p OC72 12p 2N706 10p 40408 54p BC131 45p C22 15p OC72 12p 2N706 10p 40408 54p BC131 45p C22 15p OC76 25p 2N706 12p 40408 55p BC132 45p C22 15p OC76 25p 2N701 37p 40600 56p BC133 45p C27 15p OC76 25p 2N711 37p 40600 56p BC133 45p C27 15p OC76 25p 2N711 37p 40600 56p BC133 45p C27 15p OC76 25p 2N711 37p 40600 56p BC133 45p C27 15p OC76 25p 2N711 37p 40600 56p BC133 45p C28 25p CN196 0C81 25p 2N918 45p 40488 95p BC134 12p CR33 30p (BR305AF) OC82 25p 2N190 30p 40430 97p BC173 30p CR336AF OC82 25p 2N190 30p 40430 97p BC173 30p CR336AF OC82 25p 2N190 30p 40430 97p BD131 75p MJE520 50p OC140 35p 2N1303 17p BD132 75p MJ480 97p OC140 35p 2N1303 17p BD132 75p MJ480 97p OC140 35p 2N1303 17p BD132 75p MJ480 97p OC140 35p 2N1303 22p			10p	C5V1			47p	2N5756	95p	2N4871	40p
BC168			. 9p		15p		вор		zup	2N5245	45p
BC167 11p (C775 15p) CC26 33p 26371 15p 40310 45p BC168 10p C872 15p) CC28 60p 26374 25p 40312 48p BC169 11p (C971 15p) CC29 60p 2N174 80p 40320 47p 40312 48p BC169 11p C971 15p CC25 60p 2N174 80p 40320 47p 40312 48p 40310 43p 4031			10p				gup		10p	40250	55p
BC168 10p C8V2 15p OC28 60p 26374 25p 40312 48p BC169 11p C8V2 15p OC29 60p 20374 25p 40312 48p BC169 11p C9V1 15p OC35 50p 2N3745 50p 40360 43p 43p 40360 43p 43p			111	CTV5			33p		15p	40309	45p
BC169 11p (29V1 15p 0C29 60p 2N174 80p 40320 47p BC169C 15p 1Cn 15p 0C35 60p; 2N385A, 50p 40360 43p BC182 10p C11 15p 0C36 63p; 2N388A 50p 40360 43p BC182 10p C12 15p 0C41 25p; 2N404 23p 40362 55p BC183 0p; C13 15p 0C42 30p; 2N696 15p 40406 56p BC183 0p; C15 15p 0C42 30p; 2N696 15p; 40406 56p BC183 10p; C15 15p 0C44 15p; 2N697 17p; 40407 39p BC184 12p; C18 15p 0C41 12p; 2N697 17p; 40407 39p BC184 12p; C18 15p 0C71 12p; 2N706 10p; 40408 51p BC184 12p; C18 15p 0C71 12p; 2N706 10p; 40408 51p BC184 12p; C18 15p; 0C71 12p; 2N706 10p; 40409 54p BC2121 12p; C22 15p; 0C72 12p; 2N706 A 12p; 40410 62p; BC212 12p; C22 15p; 0C75 23p; 2N708 18p; 40410 62p; BC212 12p; C22 15p; 0C75 23p; 2N708 18p; 40410 62p; BC212 12p; C22 15p; 0C75 23p; 2N708 18p; 40410 62p; BC212 12p; C22 15p; 0C75 23p; 2N708 18p; 40410 62p; BC212 12p; C22 15p; 0C75 23p; 2N708 13p; 40600 35p; BC23 2D; C24 15p; 0C75 23p; 2N714 37p; 40600 35p; BC23 2D; C14 10p; 0C81 25p; 2N714 30p; 40600 35p; BC23 2D; C14 10p; 40600 35p; BC23 2D; AC2 2D;			100	CSV2	15p		60p	20371	25p	40210	400
BC169C 15p C10 15p OC35 50p 2N385A 50p 40360 43p BC182 10p C11 15p OC36 63p 2N388A 50p 40360 55p BC182 10p C12 15p OC41 25p 2N404 23p 40362 55p BC183			11n						80p	40320	47n
BC182 10p C11 15p OC36 68p 2N388A 50p 40361 47p BC182 10p C12 15p OC41 25p 2N404 25p 40362 55p BC183 0p C13 15p OC42 30p 2N696 15p 40406 56p BC183 10p C15 15p OC44 15p 2N696 15p 40406 56p BC183 10p C15 15p OC44 12p 2N696 10p 40406 56p BC184 12p C18 15p OC71 12p 2N696 10p 40406 56p BC184 12p C18 15p OC71 12p 2N706 10p 40408 51p BC184L 12p C18 15p OC71 12p 2N706 10p 40409 54p BC2121 12p C22 15p OC72 12p 2N706 12p 40410 62p BC2121 12p C22 15p OC75 25p 2N708 16p 40468 35p BC2121 12p C22 15p OC75 25p 2N708 16p 40468 35p BC2121 12p C22 15p OC76 25p 2N708 16p 40468 35p BC2122 12p C22 15p OC76 25p 2N708 16p 40468 35p BC2123 45p C24 15p OC76 25p 2N711 37p 40600 55p BC23 25p C24 15p OC76 25p 2N711 37p 40600 55p BC23 25p C24 15p OC61 25p 2N711 37p 40600 55p BC23 25p C24 15p OC61 25p 2N711 37p 40600 35p BC23 25p C24 16p OC61 25p 2N711 37p 40600 35p BC23 25p C24 16p OC61 25p 2N711 30p 40608 40p BC23 25p C24 16p OC61 25p 2N711 30p 40608 40p BC23 25p 2N718 30p 40430 25p BC23 25p 2N718 30p 40576 21-70 BD131 75p MJE520 50p OC140 35p 2N7180 22p BC25 25p 2N7180 22p			15p	C10	15p		50p		50n	40360	48n
BC183L 10p C12 15p OC41 25p 2N404 25p 40362 55p BC183 9p C13 15p OC42 30p 2N696 15p 40406 56p BC183L 10p C15 15p OC44 15p 2N697 17p 40407 39p BC184 13p C16 15p OC45 12p 2N698 30p 40408 51p BC184 12p C16 15p OC71 12p 2N706 10p 40409 54p BC212 12p C20 15p OC72 25p 2N706 12p 40408 35p BCY30 25p C24 15p OC75 25p 2N708 16p 40468A 35p BCY30 25p C24 15p OC76 25p 2N711 A 37p 40600 55p BCY30 25p C24 15p OC76 25p 2N711 A 37p 40601 55p BCY30 25p C24 15p OC76 25p 2N711 A 37p 40601 55p BCY30 25p C24 15p OC78 25p 2N710 37p 40600 40p BCY30 25p C24 15p OC78 25p 2N710 47p 40600 55p BCY30 25p C24 15p OC76 25p 2N711 A 37p 40601 55p BCY30 25p C24 15p OC81 20p 2N911 50p 40602 40p BCY30 25p C24 15p OC81 20p 2N911 20p 40603 49p BCY30 25p CR3/55t 40p OC812 25p 2N190 30p 40430 97p BCY30 30p CR3/54C 40p OC812 55p 2N190 30p 40430 97p BCY70 30p CR3/54C 40p OC82D 15p 2N191 30p 40512 21-35 BDY30 35p BD131 75p MJE520 50p OC140 35p 2N1300 17p BD131 75p MJE520 50p OC140 35p 2N1300 25p EN150 25p			10p	C11 .			63p		50n	40361	47p
BC183 9p C13 15p OC42 30p 2N696 15p 40406 56p BC183 10p C15 15p OC44 15p 2N697 17p 40407 39p BC184 13p C16 15p OC45 12p 2N698 30p 40408 51p BC184 12p C18 15p OC71 12p 2N706 10p 40409 54p BC212 12p C22 15p OC72 12p 2N706 10p 40409 54p BC212 12p C22 15p OC75 29p 2N708 10p 40410 62p BC212 12p C22 15p OC75 29p 2N708 10p 40410 62p BC23 25p C24 15p OC76 25p 2N711 37p 40600 58p BC133 45p C27 15p OC77 40p 2N711A 37p 40600 58p BC132 45p CR1/051C 15p OC77 40p 2N711A 37p 40600 58p BC132 45p CR1/051C 15p OC77 40p 2N711A 37p 40600 58p BC133 25p CR1/051C 15p OC812 20p 2N708 16p 40468 49p BC133 25p CR1/051C 15p OC812 20p 2N708 16p 40468 49p BC134 25p CR1/051C 15p OC812 20p 2N708 40p 40600 40p BC134 25p CR1/051C 15p OC812 20p 2N708 40p 40600 40p BC134 25p CR1/051C 15p OC812 20p 2N708 40p 40600 40p BC134 25p CR1/051C 15p OC812 20p 2N708 40p 40600 40p BC134 25p CR1/051C 15p OC812 20p 2N708 40p 40600 40p BC134 25p CR1/051C 15p OC812 20p 2N708 40p 40600 40p BC134 25p CR1/051C 15p OC812 20p 2N708 40p 40600 40p 40p 40p 40p 40p 40p 40p 40p 40p 4		BC182L	10p	C12	15p	OC41	25p	2N404	23p	40362	
BC183L 10p C15 15p OC44 15p N698 17p 40407 39p BC184L 12p C18 15p OC71 12p N698 30p 40408 51p BC184L 12p C18 15p OC71 12p N7066 10p 40409 54p BC212L 12p C20 15p OC72 22p N7068 12p 40410 62p BCY30 25p C24 15p OC76 25p N70708 16p 40468A 35p BCY31 48p C27 15p OC76 25p N7111 37p 40600 58p BCY32 50p C30 15p OC77 40p N7111 37p 40601 55p BCY33 20p CR1/051C 40p OC811 20p 2N911 50p 40602 40p BCY33 20p CR1/051C 40p OC812 52p 2N918 42p 40486 49p BCY34 25p CR1/401C 60p OC812 52p 2N190 30p 40430 97p BCY71 30p CR3/40AF OC82 25p 2N190 30p 40430 97p BCY71 30p CR3/40AF OC82 25p 2N190 30p 40512 21-45 BCY71 30p CR3/40AF OC82 25p 2N190 30p 40576 21-45 BCY71 30p CR3/40AF OC82 25p 2N190 30p 40576 21-45 BD131 75p MJ480 97p OC140 35p 2N1303 27p BD132 75p MJ480 97p OC170 25p 2N1304 22p BCY24 25p 2N1904 22p 2			9n	C13	15p		30p	2N696	15p	40406	56p
BC184 13p C16 15p OC45 12p 2N698 30p 40408 51p BC1841 12p C18 15p OC71 12p 2N706 10p 40409 54p BC2121 12p C20 15p OC72 12p 2N706 12p 40410 62p BC2121 12p C22 15p OC75 23p 2N708 10p 40468 35p BCY30 25p C24 15p OC76 25p 2N711 37p 40600 58p BCY30 25p C24 15p OC77 25p 2N711 37p 40600 58p BCY30 25p C24 15p OC77 25p 2N711 37p 40600 58p BCY30 25p C30 15p OC87 20p 2N711 37p 40600 40p BCY30 25p C30 10p OC87 20p 2N711 37p 40600 40p BCY30 25p C30 20p C30 20p 2N711 37p 40600 40p BCY30 25p C30 20p C30 20p 2N711 30p 40602 40p BCY30 25p C30 20p C312 20p 2N711 20p 40603 40p BCY30 25p C30 20p C312 20p 2N711 20p 40603 40p BCY30 25p C30 20p C312 20p 2N711 20p 40603 40p BCY30 25p C30 20p C30 20p 2N711 20p 40603 40p BCY30 25p C30 20p 2N711 20p 40603 20p BCY30 25p C30 20p 2N711 20p 40603 20p BCY30 25p C30 20p 2N711 20p 40602 20p 2N711 BCY71 25p C30 20p 2N711 20p 40603 20p 2N711 BCY71 25p C30 20p 2N711 20p 40603 20p 2N711 BCY71 25p C30 20p 2N711 20p 40600 20p 2N711 BD131 75p MJE20 50p OC140 25p 2N7130 22p BCY70 25p 2N7130 25p 20 25p BCY70 25p 2N7130 25p 20 25p			10n			OC44	15p		17p		39p
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			13p		15p		12n		30p	40408	51p
BCY30 25p C22 15p C076 25p 2N708 15p 4468A 35p BCY30 25p C24 15p C076 25p 2N711A 37p 40600 55p BCY33 25p C27 15p C077 40p 2N711A 37p 40600 55p BCY33 25p CR1/051C 40p C081D 20p 2N911 20p 40603 49p BCY34 25p CR1/051C 40p C081D 25p 2N918 42p 40486 495p BCY36 25p 2N198 42p 40486 40p 40			12p		15p		12p		10p	40409	54p
BCY39 25p (224 15p) 0C76 25p 2N711 37p 40600 58p BCY31 45p (27 15p) 0C77 40p 2N711A 37p 40600 58p BCY32 50p (23 15p) 0C81 20p 2N7911 50p 40602 40p BCY33 20p (RI/051C 40p 0C81D 20p 2N9914 20p 40603 49p BCY34 25p (RI/401C 60p 0C81Z 55p 2N918 42p 40486 95p BCY34 30p (RS305AF 0C82 25p 2N1990 30p 40439 97p BCY70 15p BCY71 30p CRS305AF 0C82 25p 2N1090 30p 40439 97p BCY71 30p CRS305AF 0C82 25p 2N1090 30p 40430 97p BCY71 30p CRS305AF 0C82 25p 2N1090 30p 40430 97p BCY71 15p BCY71 30p CRS3/40AF 0C83 25p 2N1131 30p 40512 21.45 BCY72 15p 2N193 25p 2N1302 17p BD131 75p MJE520 50p 0C140 35p 2N1302 17p BD132 75p MJ480 97p 0C140 35p 2N1303 17p BCY30 25p 2N1304 22p BCY30 25p 2N1304 25p 2			120				120		120	40410	
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BCY32 50p (C30 15p C0S1 20p 2N911 50p 40602 40p 5C92 30p CR1/051C 40p C0CS1D 20p 2N914 20p 40603 49p 3C92 30p CR1/051C 40p C0CS1D 20p 2N914 20p 40603 49p 3C92 30p CR3/051AF C0C32 25p 2N918 42p 40486 95p 3C92 30p 2N910 30p 40430 97p 3C92 30p 2N910 30p 40430 97p 3C92 30p 2N910 30p 40430 97p 3C92 30p 2N910 31 30p 40512 21-35 3C93 20p			48n				40r		37p		
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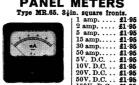
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2N718A 30p 2N3691 15p 40309 2N726 30p 2N3692 18p 40310	32p BC157 15p BFY30 40p NKT401 87p 45p BC158 11p BFY41 50p NKT402 90p	CA3028B FJY101 25p SN7493 87p 105p IC10 250p SN7495 87p CA3029 87p IC12 250p SN7496 87p	6AG7 40p 35Z5 50p PC88 60p 6AK5 35p 50B5 50p PC97 45p
2N914 17p 2N3694 18p 40312 2N916 17p 2N3702 10p 40314	47p BC160 35p BFY50 20p NKT404 55p 37p BC167 11p BFY51 20p NKT405 75p	CA3029A L900 40p SN74107 52p 165p L914 40p SN74153	6AL5 20p 80 55p PCC84 40p 6AM6 30p 85A2 50p PCC85 40p
2N918 30p 2N3703 10p 40315 2N929 22p 2N3704 11p 40316 2N930 20p 2N3705 10p 40317	77 BC168B 10p BFY52 20p NKT406 62p 47p BC168C 11p BFY53 15p NKT451 62p 37p BC169B 11p BFY56A 57p NKT452 62p	CA3035 122p LM380 122p SN74154 CA3036 72p MC724P 60p 200p	6AQ5 38p 807 50p PCC88 55p 6AS6 40p 1625 50p PCC89 50p 6AT6 35p 5763 70p PCC189 55p
2N987 40p 2N3706 9p 40319 2N1090 22p 2N3707 11p 40320 2N1091 22p 2N3708 7p 40323	55p BC169C 12p BFY76 42p NKT453 47p 47p BC170 12p BFY77 57p NKT713 20p 32p BC171 15p BFY90 65p NKT717 42p	CA3039 82p MC780P 247p SN74160 CA3041 109p MC788P 146p 180p CA3042 109p MC790P 124p SN74161	6AU6 25p 6146 160 PCF80 30p 6AV6 30p AZ31 55p PCF82 34p 6BA6 25p CY31 35p PCF84 60p
2N1131 25p 2N3709 9p 40324 2N1132 25p 2N3710 9p 40326 2N1302 17p 2N3711 12p 40329	47p BC172 15p BSX19 17p NKT734 27p 37p BC175 22p BSX20 15p NKT736 35p 30p BC177 20p BSX21 20p NKT773 25p	CA3043 137p MC792P 66p 260p CA3044 120p MC799P 66p SN74164 CA3045 122p MC1303L 220p	6BE6 30p DAF91 30p PCF86 60p 6BH6 75p DAF96 45p PCF800 80p 6BJ6 50p DF91 22p PCF801 50p
2N1303 17p 2N3713 187p 40344 2N1304 22p 2N3714 200p 40347 2N1305 22p 2N3715 123p 40348	27p BC178 20p BSX26 45p NKT781 30p 57p BC179 20p BSX27 47p OC16 50p 52p BC182 10p BSX28 32p OC19 37p	CA3046 81p 200p SN74165 CA3047 137p MC1304P 225p CA3048 204p 225p SN74192	6BQ7A 40p DF96 45p PCF802 50p 6BR7 90p DK91 40p PCF805 80p 6BR8 70p DK92 55p PCF806 70p
2N1306 25p 2N3716 130p 40360 2N1307 25p 2N3773 240p 40361 2N1308 25p 2N3791 206p 40362	40p BC182L 10p BSX60 82p OC20 75p 40p BC183 9p BSX61 62p OC22 50p 50p BC183L 9p BSX76 15p OC23 60p	CA3049 160p MC1305P 175p CA3050 185p 386p SN74193 CA3051 134p MC838P 175p	6BW6 85p DK96 50p PCF808 75p 6BW7 80p DL92 35p PCL82 35p 6BZ6 40p DL94 48p PCL83 65p
2N1309 25p 2N3819 34p 40370 2N1507 17p 2N3820 55p 40406	32p BC184 11p BSX77 20p OC24 60p 57p BC184L 11p BSX78 25p OC25 40p	CA3052 165p 549p TAA241 CA3053 46p MC1435P 162p CA3054 109p 345p TAA242	6C4 33p DL96 45p PCL84 45p 6CD6 125p DM70 40p PCL85 40p
2N1631 35p 2N3854 27p 40408 2N1632 30p 2N3854A 27p 40409	52p BC187 27p BSY25 15p OC28 60p 55p BC212L 12p BSY26 17p OC29 60p	CA3055 240p MC1552G 425p CA3059 165p 461p TAA243 150p	6CL6 50p DY86 32p PCL86 45p 6CW4 65p DY87 33p PFL200 65p 6F1 62p E88CC 100p PL36 55p
2N1637 30p 2N3855 27p 40410 2N1638 27p 2N3855A 30p 40412 2N1639 27p 2N3856 30p 40467	62p BC213L 12p BSY27 15p OC35 50p 50p BC214L 15p BSY28 17p OC36 60p 57p BCY10 27p BSY29 17p OC41 22p	FCH101 85p 94p TAA293 97p FCH111 105p MFC4000P TAA300 175p	6F6G 35p E180F 100p PL81 50p 6F13 45p EABC80 35p PL82 45p 6F14 70p EAF42 35p PL83 45p
2N1701 162p 2N3856A 35p 404682 2N1711 24p 2N3858 25p 40528 2N1889 32p 2N3858A 30p 40600	72p BCY31 30p BSY36 25p OC44 15p 57p BCY32 50p BSY37 25p OC45 12p	FCH121 105p	6F15 65p EB91 20p PL84 40p 6F18 50p EBC41 55p PL500 75p 6F23 85p EBC81 30p PL504 80p
2N1893 37p 2N3859 27p 40603 2N2147 72p 2N3859A 32p AC107 2N2160 57p 2N3860 30p AC126	50p BCY33 25p BSY38 20p OC46 15p 30p BCY34 30p BSY39 22p OC70 15p 20p BCY38 40p BSY43 50p OC71 12p	FCH151 105p PA234 92p TAA435 147p FCH171 105p PA237 210p TAA521 132p FCH181 105p PA246 150p TAA522 360p	6H6 17p EBF80 40p PY32 55p 6J4 50p EBF83 40p PY33 63p 6J5 25p EBF89 32p PY80 40p
2N2193 40p 2N3866 150p AC127 2N2193A 42p 2N3877 40p AC128 2N2194 27p 2N3877A 40p AC151	24p BCY39 60p BSY51 32p OC72 12p 20p BCY40 50p BSY52 32p OC73 30p 18p BCY41 15p BSY53 37p OC74 30p	FCH191 105p PA424 235p TAA530 495p FCH201 130p PA264 190p TAA811 445p FCH211 130p PA265 200p TAB101 97p	6J5GT 30p EBL21 60p PY81 30p 6J6 20p EC86 60p PY82 35p 6J7 45p EC88 60p PY83 38p
2N2194A 30p 2N3900 37p AC152 2N2217 25p 2N3900A 40p AC154	22p BCY42 15p BSY54 40p OC75 22p 22p BCY43 15p BSY56 90p OC76 22p 20p BCY54 32p BSY79 45p OC77 30p	FCH221 130p SN7400 20p TAD100 150p FCH231 150p SN7401 20p TAD110 150p FCJ101 160p SN7402 20p SL403D 15 p	6K8G 40p ECC40 65p PY88 40p 6L6GT 45p ECC84 30p PY800 40p
2N2219 20p 2N3903 20p AC187 2N2220 25p 2N3904 25p AC188	25p BCY58 22p BSY90 57p OC78 20p 25p BCY59 22p BSY95A 12p OC81 20p	FCJ111 150p SN7403 20p SL702C 147p FCJ121 275p SN7404 20p UA702A 280p FCJ131 275p SN7405 20p UA702C 77p	6LD20 50p ECC85 40p PY801 50p 6Q7 40p ECC88 40p U25 80p 6SA7 40p ECF80 35p U26 80p
2N2222 20p 2N3906 25p ACY19 2N2222A 25p 2N4058 12p ACY19	24p BCY70 15p C450 15p OC82 25p 24p BCY71 20p GET102 30p OC82D 15p	FCJ141 525p SN7406 80p UA703C 137p FCJ201 100p SN7408 20p UA709C 45p	68G7 40p ECF82 35p U50 40p 68J7 40p ECF86 65p U52 35p 68K7 40p ECH21 57p U191 75p
2N2297 30p 2N4059 10p ACY20 2N2368 15p 2N4060 12p ACY20 2N2369 15p 2N4061 12p ACY20	20p BCY78 30p GET114 20p OC84 25p 10p BCY79 30p GET118 20p OC139 25p	FCJ211 275p SN7409 20p UA710C 125p FCK101 430p SN7410 20p UA716 187p FCL101 230p SN7411 23p UA723C 100p	68L7 35p ECH35 100p U281 40p 68N7 35p ECH42 75p U282 40p 68Q7 40p ECH81 30p U301 40p
2N2369A 15p 2N4062 12p ACY26 2N2410 42p 2N4244 47p ACY36 2N2483 27p 2N4248 15p ACY46	47p BCZ11 40p GET873 12p OC170 25p 20p BD112 50p GET880 30p OC171 30p	FCY101 102p SN7413 30p UA730C 160p FJH101 25p SN7420 20p UA741C 80p BRIDGE 50 PIV 4A 40p	6U4 65p ECH83 45p U801 £1.80 6V6G 25p ECL80 45p UABC80 40p 6V6GT 32p ECL82 35p UAF42 55p
2N2484 32p 2N4249 15p ACY4 2N2539 22p 2N4250 18p ACY4 2N2540 22p 2N4254 42p AD140	25p BD121 65p GET889 22p OC201 60p 47p BD123 80p GET890 22p OC202 75p	RECTIFIERS 100 PIV 4A 50p 200 PIV 4A 55p	6X4 35p ECL83 70p UBC41 50p 6X5G 30p ECL86 40p UBC81 40p 6X5GT 40p EF37A 120p UBF80 40p
2N2613 35p 2N4255 42p AD149 2N2614 30p 2M4284 17p AD150 2N2646 40p 2N4285 17p AD161	47p BD124 60p GET896 22p OC203 40p 62p BD131 75p GET897 22p OC204 40p 35p BD132 80p GET898 22p OC205 75p	ENCAPSULATED 600 PIV 4A 70p 600 PIV 1A 50p 50 PIV 6A 45p	10C2 50p EF39 50p UBF89 35p 10F1 75p EF40 50p UCC84 49p 10P13 60p EF41 65p UCC85 40p
2N2711 25p 2N4286 17p AD162 2N2712 25p 2N4287 17p AF109 2N2713 27p 2N4288 15p AF114	35p BDY10 125p MAT100 25p OC206 95p 45p BDY20 105p MAT101 25p OC207 75p 25p BDY61 125p MAT120 25p OCP71 42p	50 PIV 2A 45p 100 PIV 6A 55p 100 PIV 2A 50p 200 PIV 6A 65p 200 PIV 2A 55p 400 PIV 6A 75p	10P14 £1·10 EF42 70p UCF80 55p 12AT6 30p EF80 25p UCH21 60p
2N2714 30p 2N4289 17p AF115 2N2904 20p 2N4290 12p AF116 2N2904A 25p 2N4291 15p AF117	25p BDY62 100p MAT121 25p ORP12 50p 25p BF115 25p MJ400 107p ORP60 40p 20p BF117 47p MJ420 80p ORP61 42p	SILICON RECTIFIERS	12AU7 30p EF86 30p UCH81 40p 12AX7 30p EF89 28p UCL82 35p
2N2905	60p BF152 28p MJ421 80p P346A 22p 30p BF154 20p MJ430 102p ST140 15p	MINIATURE WIRE ENDED PLASTIC SERIES IN PL CL 1 AMP 1-5 AMP 3 AMP	12AV6 40p EF91 30p UCL83 60p 12BA6 40p EF92 35p UF41 60p 12BE6 40p EF183 35p UF80 35p
2N2906A 25p 2N4964 15p AF125 2N2907 23p 2N4965 18p AF126	19p BF159 35p MJ480 97p TIS34 62p 19p BF163 35p MJ481 125p TIS43 40p	4001 50PIV 7p 8p 19p 4002 100PIV 7p 9p 20p 4003 200PIV 8p 10p 22p	12BH7 45p EF184 35p UF85 40p 19AQ5 35p EH90 40p UF89 40p 20D1 50p EL34 50p UL41 65p
2N2923 15p 2N5027 52p AF127 2N2924 15p 2N5028 57p AF139 2N2925 15p 2N5029 47p AF178	16p BF167 18p MJ490 100p TIS44 10p 28p BF170 38p MJ491 137p TIS45 27p 42p BF173 19p MJE340 50p TIS46 11p	4004 400PIV 8p 10p 25p 4005 600PIV 10p 12p 26p 4006 800PIV 12p 15p 27p	20F2 65p EL33 £1·25 UL84 40p 20L1 £1·10 EL41 60p UY41 48p 20P1 50p EL42 65p UY85 40p
2N2926G 10p 2N5030 42p AF179 2N2926O 10p 2N5172 12p AF180 2N2926Y 10p 2N5174 52p AF181	45p BF177 30p MJE370 80p TIS47 11p 50p BF178 25p MJE371 80p TIS48 12p 40p BF179 30p MJE520 60p TIS49 12p	4007 1000PIV 15p 16p 30p 50+ less 15% 100+ less 20% SILICON RECTIFIERS	20P3 60p EL81 55p VR108/30 38p 20P4 £1-10 EL84 25p VR150/30 35p 20P5 £1-20 EL85 43p Add 12p in £
2N3011 20p 2N5175 52p AF186 2N3014 32p 2N5176 45p AF239 2N3053 18p 2N5232A 30p AF279	39p BF180 35p MJE521 70p TIS50 12p 30p BF181 32p MPF102 42p TIS51 10p 47p BF182 30p MPF103 35p TIS52 11p	STUD MOUNTING 6A 10A 17·5A 35A	25L6 50p EL91 35p for postage
2N3054 46p 2N5245 45p AF280 2N3055 60p 2N5246 42p AFZ11 2N3133 30p 2N5249 67p ASY20	47p BF184 20p MPF104 37p T1853 22p 32p BF185 20p MPF105 37p XB112 12p 25p BF194 15p MPS3638 32p XC141 35p	100PIV — 45p 50p £1·22 200PIV 25p 50p 55p £1·42 400PIV 30p 55p 62p £1·77	1N34A 10p BA154 12p GJ7M 37p 1N914 7p BAX13 12p OA5 17p 1N916 10p BAX16 7p OA6 12p
2N3134 15p 2N5265 325p ASY2' 2N3135 25p 2N5305 37p ASY2' 2N3136 25p 2N5306 40p ASY2'	24p BF196 15p NKT125 27p ZTX108 12p 27p BF197 15p NKT126 27p ZTX109 15p	600PIV 32p 60p 72p £2·12 800PIV 35p 75p 87p £2·47 1000PIV 40p 85p £1·05 £2·77	AA119 7p BAY31 7p OA10 22p AA129 10p BAY38 15p OA9 10p AA213 10p BY100 15p OA47 8p
2N3390 25p 2N5307 37p ASY5 2N3391 20p 2N5308 37p ASY5 2N3391A 30p 2N5309 62p ASY5	25p BF198 15p NKT128 27p ZTX300 12p 32p BF200 35p NKT135 27p ZTX301 15p	50 + less 15% 100 + less 20% ZENER DIODES	AAZ15 10p BY103 22p OA70 7p BA100 15p BY122 37p OA73 10p
2N3392 17p 2N5310 42p ASY6 2N3393 15p 2N5354 27p ASY8 2N3394 15p 2N5355 27p ASZ2	45p BF225 19p NKT210 30p ZTX303 20p 32p BF237 22p NKT211 30p ZTX304 25p	400MW 3·3·33 V 2·4—100 3·9—100V 10p each 25p each 40p each	BA102 30p BY124 15p OA79 7p BA110 25p BY126 12p OA81 8p BA111 27p BY127 15p OA85 7p BA112 70p BY164 52p OA90 7p
2N3402 22p 2N5356 32p AUYI 2N3403 22p 2N5365 47p BC107	0 150p BF244 23p NKT213 30p ZTX501 15p 10p BFW61 47p NKT214 20p ZTX502 20p	25 + less 15% 100 + less 20% TRANSISTOR DISCOUNTS:- 12 + 10%; 25 + 15% : 100 + 20% any one type Post-	BA115 7p BY210 35p OA91 7p BA141 32p BYZ11 30p OA95 7p BA142 32n BYZ12 30n OA200 7p
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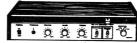


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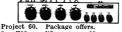
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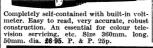




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everyday electronics

PROJECTS... THEORY....

FOR ALL SEASONS

Our cover this month has quite an outdoor touch. Of course, you don't have to be an apiarist to sense that things are beginning to buzz in the outside world. Spring is now well advanced and thoughts are likely to be turning towards all kinds of pastimes and occupations for the coming summer months.

It is an appropriate time to point out that do-ityourself electronics has no closed season. Outdoor activities like gardening, touring, camping, sporting events, and so on, present many unique opportunities for putting electronics to effective use. So we advise, take stock now, anticipate your needs and start building to remedy any deficiencies in this respect.

GOOD COMPANION

The Constructors Companion given free with every copy of this month's Everyday Electronics is small and compact. It has been designed for your pocket, so that wherever you go you can have essential facts constantly at hand. Compiled with the beginner particularly in mind, this booklet will prove a valuable aide-memoire for the more experienced constructor as well.

Those still feeling their feet will be glad of the technical back-up they can instantly call upon when confronted with a choice of allegedly alternative or equivalent parts when shopping personally for components.

READY ACCESS

Our regular readers will already appreciate the amount of important and useful information they are accumulating, as the months go by. True, not everyone will have an immediate need for every project described. But a word of advice: do not discard back numbers. You never know when circumstances may arise that create a definite need which some previously described project would satisfy exactly.

This leads us on to another common problem: how to store numerous copies of a magazine so that ready access may be made at any time to one particular article. The only really satisfactory solution is to keep copies of the magazine in the binder specially designed to hold 12 issues of Everyday Electronics and which is now available.

feel Bennett

Our June issue will be published on Friday, May 19

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.EASY TO CONSTRUCT .SIMPLY EXPLAINED



VOL. I NO. 7 MAY 1972

CONSTRUCTIONAL PROJECTS

AUDIO TONE GENERATOR Suitable for making elect	ronic music by F. C. Judd 356
BEE COUNTER An electronic eye for the hive by G. A. C.	ozens 376
METAL LOCATOR Detects and locates metal objects un	derground by D. Bollen 38.

GENERAL FEATURES

2. 하는 보고 보고 있으면 하는 말이 되었다고 25. 보고 1. 14.1 보고 1. 15.1 보고 1. 15. 15. 15. 15. 15. 15. 15. 15. 15.	
EDITORIAL	356
SHOP TALK New products and this month's constructionals by Mike Kenward	362
MAKING ELECTRONIC SOUNDS AND MUSIC Using the Audio Tone Generator by F. C. Judd	363
PLEASE TAKE NOTE	367
THEY MADE THEIR MARK No. !—Introduction By J. E. Gregory	368
TEACH-IN Part 7—Semiconductors: Transistors by Mike Hughes	369
RUMINATIONS by Sensor	374
TEACH-IN HALF TERM TEST ANSWERS See how well you did	389
READERS LETTERS Your news and views 39	0, 393

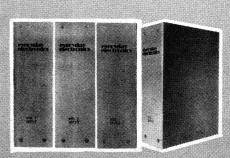
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BY FRED JUDD

This simple tone generator covers the audio range from 50 to 2,000 Hz and has been specifically designed for use with a tape recorder to make electronic music.

The multivibrator is one of the most commonly used electronic oscillator circuits and generates an almost square waveform. It can be made to cover a wide frequency range without the need for switching in different values of components and moreover will produce a high output signal level for a relatively small supply voltage. As a primary signal generator it has many uses as a test instrument in audio as well as electronic applications.

The generator described in this article is used as a tone source for the creation of electronic music and "science fiction" sound effects in conjunction with a tape recorder. The feature *Electronic Sounds and Music* on page 363 deals with the use of the tone generator in detail.

GENERATOR CIRCUIT

The circuit diagram is given in Fig. 1 and employs three pnp transistors, two of which form the multivibrator (TR1 and TR2), the remaining one, TR3, being used as a squaring amplifier.

The operating frequency and mark to space ratio (see Fig. 2) of the multivibrator are set by the time taken for C2 and C3 to charge up enough to switch transistors TR2 and TR1 respectively. This "charging time" is determined by the value of the capacitor and the value of the resistor through which it is charged.

Providing the time taken for each capacitor to charge is similar then the mark to space

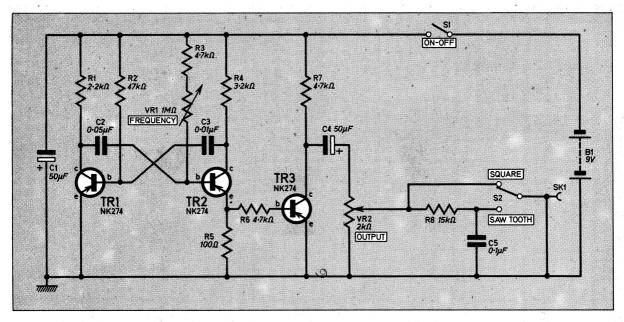


Fig. 1. Complete circuit diagram of the Audio Tone Generator.

ratio will be 1 to 1 or the mark and space will be of similar duration (Fig. 2). If we now change one of the controlling values—in this case VR1—both the frequency and mark to space ratio will be altered.

If we increase the value of VR1 the frequency will decrease as C2 will take longer to charge, and the mark to space ratio will alter for the same reason (see Fig. 3). Thus frequency control is achieved by VR2 and the total frequency range is approximately 50 to 2,000Hz.

The waveform has a mark to space ratio of 1 to 1 at approximately 1,500Hz at all lower frequencies the mark to space ratio increases becoming about 1 to 20 at the lowest frequency (Fig. 3).

The output from the multivibrator is taken from the emitter of TR2, through R6 to the base of TR3. Transistor TR3 is switched hard on and off by the output from TR2 and thus ensures a completely square output at its collector. The output level from TR3 is continuously variable from O to approximately 7 volts by VR2.

SAWTOOTH OUTPUT

The square wave output from TR3 can also be switched via S2 through an integrating network, C5 and R8, to provide an approximately sawtooth waveform (Fig. 4) of about 1 volt peak-to-peak maximum output, instead of the square-wave.

One of the major differences between a square wave and a sawtooth wave is the harmonic content and hence the tonal quality, when either are made audible via an amplifier and loudspeaker. The square wave contains only odd harmonics, in addition to its fundamental,

whereas a sawtooth wave consists of both odd and even harmonics plus the fundamental.

Audibly the square wave has a sound rather like that produced by a clarinet particularly in the region of middle C (261Hz approx.). The sawtooth wave has a sound rather more like a

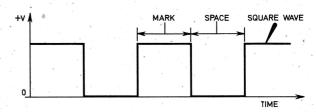


Fig. 2. A square wave with a 1 to 1 mark to space ratio.

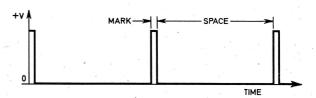


Fig. 3. A square wave with a 1 to 20 mark to space ratio.



Fig. 4. A sawtooth waveform.

Audio Tone Generator

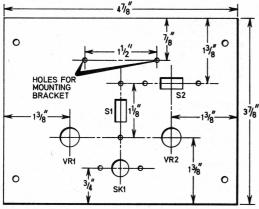


Fig. 5. Front panel drilling details.

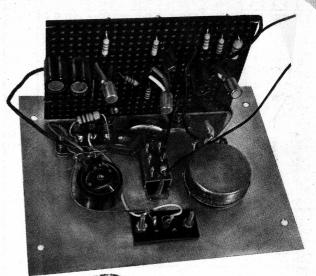
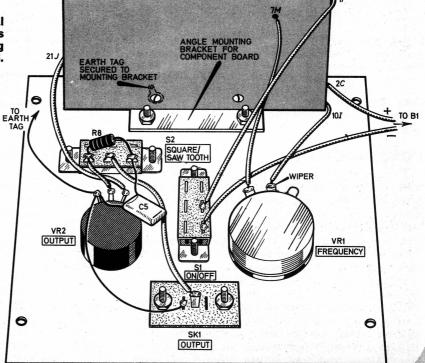




Fig. 7. Wiring of the final unit. The tinted area is the component mounting board as shown in Fig. 6.



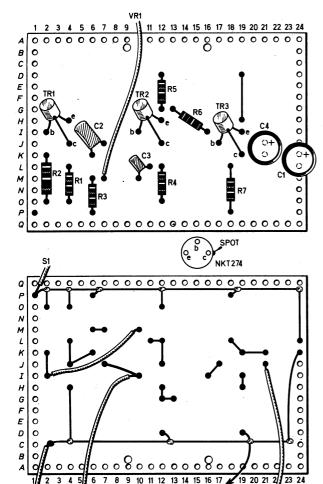


Fig. 6. Top and underside views of the component board. The transistor connections between the two diagrams are viewed from the underside.

TO EARTH TAG

flute. Both waveforms are used extensively in electronic organ voicing and for electronic music.

CONSTRUCTION

VR1 WIPER

B1+ve

The prototype unit was housed in a box made from universal chassis parts. The pieces used assemble into a box measuring 5 by 4 by 3 inches. The sides and top and bottom can be assembled leaving one plate for the front panel and one for the rear. The plate used for the front panel is drilled as shown in Fig. 5 and is used to mount all the components.

If the layout and assembly of the generator is as shown there is just room in the case for a PP9 9 volt battery. Even if you spread the layout a little there should still be room for a slightly smaller 9 volt battery. The circuit board is 0.15inch matrix plain perforated veroboard and is mounted on a 2 inch length of 38 by 38 inch aluminium angle.

Components....

Resistors

R1 $2 \cdot 2k\Omega$ R2 $47k\Omega$ R₃ 4 · 7kΩ R4 $3 \cdot 2k\Omega$ R₅ 100Ω R6 4 · 7kΩ R7 4 · 7kΩ

15k Ω All 4W ±10% carbon

Capacitors

R8

50 nF elect. 12V C1 C2 0.05 nF

C3 0.01nF

C4 50/1F elect. 12V

0.1*µ*F

Transistors

TR1 NKT 274 germanium pnp TR2 NKT 274 germanium pnp TR3 NKT 274 germanium pnp

Potentiometers

VR1 1M Ω log carbon VR2 2kΩ lin carbon

S1 S.P.S.T. slide S.P.D.T. slide

Miscellaneous

SK1 Phono socket PP9 9V battery

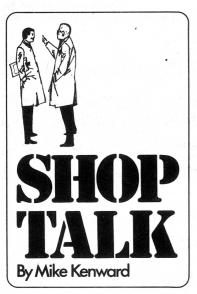
Control knobs (2 off) Eagle type F10, case 5 x 4 x 3in made from universal chassis panels or a similar size case, battery connector, aluminium angle 2 x 3 x 3 in. Veroboard 5 x 4 x 0 15in matrix plain perforated, earth tag, connecting wire, 4BA fixings.

Commence wiring of the component board by inserting all components except the transistors, and the wire link on the top of the board as shown in Fig. 6. Turn the board over and connect up the two supply lines along the two sides of the board using 18 or 22 s.w.g. tinned copper wire. Next connect up the remaining components using the component leads where possible and connect the flying leads.

Finally insert the transistors checking carefully the lead connections with the underside view shown in Fig. 6, and solder them to the other components using a heat shunt on each lead as it is soldered. After checking the circuit board mount the board on the aluminium angle bracket and mount this on the front panel together with the remaining components.

Wire up all the components to the circuit board as shown in Fig. 7 and check the completed unit carefully before connecting the battery and switching on.

Continued on page 386



This month we have one item which many readers will probably wish to construct but which is not given in the form of a constructional project. It is the simple passive mixer that is described and drawn up in the Making Electronic Sounds and Music feature.

Since this is really a bonus that will be useful to those following the article we have not given full constructional details or a components list. All the component values are given on the circuit diagram and the wiring diagram shows how they are put together. The three sockets can be any type suitable for use with your particular tape recorder—the types we have shown are phono sockets.

The complete unit can be mounted in any small case. No battery or power supply is necessary. We would like to emphasise that this is a simple passive mixer and will not be able to cope with all inputs.

A more advanced type of mixer may form the subject of a future article. However this simple mixer should be suitable for use with the *Audio Tone Generator* that is also described in this issue.

Audio Tone Generator

There should be very few buying problems for the Audio Tone Generator. As described above the sockets could be changed to any suitable type if your equipment does not use phono sockets or if you already

have other types. Once again the case for this project can be any type that is available in a suitable size.

Bee Counter

We find it difficult to comment on the availability of cedar wood —not after-shave—but apparently this wood must be used or the bees will not accept it!

As far as the remaining components for the *Bee Counter* go make sure that the resistors you buy are of adequate wattage. The lamp and holder should be of the miniature type so that they can be accommodated in the wooden base panel. Since the current drawn by this circuit is fairly large the section in the article concerning the battery should be noted.

There are a number of Post Office type counters available so make sure you get the right one —4·2 ohms coil resistance is the important thing.

Metal Locator

The Metal Locator is a project which we are sure will create great interest but please remember that this is a simple one-transistor design and cannot be expected to out-perform a £30 unit. The use of Perspex or Paxolin is recommended for the locator head as these materials are not affected by damp or water.

All remaining components for the locator should be readily available. The use of a subminiature switch is recommended since only a small hole then needs to be cut in the plastic beaker. Any 50μ A moving coil meter could be used in the locator provided it will fit the beaker lid. The one specified is probably the cheapest.

Finally do not forget the operating licence and don't say we did not tell you!

New Products

Two products from one goahead firm have been introduced this month. Both in the audio field, possibly the most outstanding is the Unisound 505 as Radio and T.V. Components call their do-it-yourself £25 stereo system. This competitively priced unit comes as a complete kit and only needs two screwdrivers to put together. All the electronics are in module form and are supplied

with wiring looms that only need connecting up using a screwdriver supplied with the kit.

The large EMI speakers are housed in attractive cabinets again put together with only a screwdriver. It is said that anyone who can wire up a mains plug can put the system together in one evening. The system utilises modified Mullard Unilex modules, has an output of 3.7 watts continuous sine wave r.m.s. per channel; and frequency response of 40Hz to 20kHz at the 3dB down points. It would be very difficult to buy the individual components -including Garrard 2025TC deck, cartridge, plinth and cover and build a unit to match this one for £25, excluding the two speakers and cabinets.



The second unit from RT-VC is a £7 push button car radio kit, slightly more difficult to construct but any reader who has some experience of soldering should be able to build a working unit.

The kit is of good quality and uses the same push button tuning unit as radios costing three or four times the price. These features ensures good sensitivity and the pre-aligned i.f. (intermediate frequency) module and tuner avoid complicated alignment.

The kit is suitable for 12V positive or negative earth operation and readers may like to note that an after sales service—to repair any item not functioning correctly—is operated by RT-VC for all their kits; cost about £2 depending on the fault.





Simple experiments with a tape recorder

The term "electronic music" almost defies explanation because it is not the music that is electronic but the equipment and methods of creating it.

Its origin goes back many years, in fact to the invention of the thermionic valve and even as early as 1921 a "concert" of electronic music was performed in Paris by an Italian, Luigi Russolo, who used what was then called electrical sound generating and reproducing equipment.

Electronic music was difficult to perform directly from sound generators, etc., because composition required arranging the sounds in a given order and even changing the order, and sometimes the sounds, at a later time.

MODERN METHODS

Magnetic tape recording finally provided the ideal medium for composition. The sounds required could be recorded and rearranged afterwards by simply cutting out the pieces of tape containing them and splicing these together again in the order required. This technique paved the way for composers who, with both electronics and magnetic tape at their disposal, could produce new kinds of music with tonal qualities never before possible.

More recently of course the music synthesizer has taken over the task of tone generation, etc., and electronic music composers can now programme a synthesizer, couple it to a tape recorder and produce "instant" electronic music.

Nevertheless there is much that can be accomplished by the amateur with an ordinary domestic tape recorder, an audio tone generator (like the one described on page 358) and some splicing tape. The techniques are simple and you can get a good deal of fun out of experimental electronic music and "science fiction" sounds.

Your efforts need not be wasted either because you can enter them for the experimental music and sounds section of the annual British Tape Recording Contest (details later).

EQUIPMENT

An ordinary spool to spool tape recorder is the main requirement and if you have a stereo recorder with provision for recording independently on either track or you can get together with a friend and use two tape recorders, so much the better. A tape recorder with track-to-track or duoplay facility is also advantageous especially if it permits echo effects.

It is not possible to lay down procedures for specific makes and types of tape recorder but you will find that most of the techniques described can be applied.

Note that cassette or cartridge tape recorders are of limited use for creative recording of this nature which requires fairly extensive tape

cutting and splicing.

Most modern spool to spool tape recorders are designed for stereo operation employing half or quarter track on standard quarter inch wide tape. If the tape recorder has a track-to-track recording facility it will have separate recording and replay heads, thus allowing a recording on one track to be copied on to another together with other signals.

Some stereo recorders may only have a common record/replay head which will not normally allow track-to-track copying but may have a facility for making separate recordings on each of two tracks. Information concerning such facilities should be given in the tape recorder instruction book. If in doubt, you should contact your dealer or the manufacturer for such information.

AUDIO TONE GENERATOR

An audio tone generator is not absolutely essential but is most advantageous. The simple *Audio Tone Generator* described on page 358 is quite suitable as it covers a wide enough frequency range and will deliver a square-wave or a nearly sawtooth-wave output signal, thus providing two basic sounds.

Sounds picked up by a microphone can also be used because these can be reshaped by tape cutting and splicing and by certain recording techniques. Magnetic tape will be required of course and for initial experimental work low priced brands will suffice.

Some splicing tape and blank leader tape will also be required. Do not use ordinary plastic sticky tape, such as Sellotape, for splicing as

Fig. 1. (a) Original waveform of the recorded sound (b) The sound recorded and shown in (a) played in reverse.

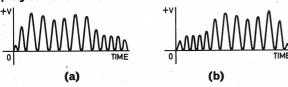




Fig. 2. Waveform of a sound which starts instantly and slowly dies away.

this may damage the tape and will not give a long lasting joint. Small kits of coloured leader and proper splicing tape are readily available. A small tape splicer is also a very useful, though not essential, tool.

FIRST EXERCISES

It is important to know the extent to which your tape recorder can be used. If it has two or three speeds, as most of them do, record some musical sounds, whistling will do, at all three speeds and then play them back at one speed only, say the highest.

The sounds recorded at the lower speed(s) will be raised in pitch, by one or two octaves, depending on the speed. If the replay speed is double that of the recording speed the pitch is raised one octave and the sounds will occur faster but if the replay speed is half the recording speed, the pitch will be reduced by one octave and the sounds will occur slower. This is one of the most simple but most used techniques.

REVERSE REPLAY

Now, if your recorder is a stereo machine try turning the tape over (reverse the spools) and see if you can obtain replay on another track in reverse, i.e., the sounds will be going backwards. This technique is also commonly used for electronic music because it alters the nature of the sound completely by placing what was the beginning of the sound, i.e., its attack, at the end as illustrated in Fig. 1 in which (a) is the sound as recorded and (b) as played in reverse.

If you cannot play sounds in reverse try this exercise; connect a tone generator, or if this is not available record whistles through a micro-

Photograph showing the use of a tape splicer to join up a number of sounds.



Everyday Electronics, May 1972



Recording various sounds, using the microphone, to form a composition.

phone. Start with the recording level control at the maximum, set the tape running to record the sound but then almost simultaneously slowly turn the record level control to zero.

On replay you will have a sound that starts instantly and then slowly dies away as in Fig. 2. With a little practice you will be able to get various dying away or decay times depending on the speed at which the recording level control is turned off. Now try the reverse procedure; gradually increase the sound whilst recording and then quickly stop it.

TAPE CUTTING EXERCISES

Now try some tape cutting; first use the highest tape speed and record a few sounds of different pitch, i.e., from a tone generator, or whistles via the microphone, each one lasting two or three seconds.

Locate the beginning of each sound on the tape by carefully feeding the tape across the head and then cut the tape about two inches in front of the sound. Run off the remainder until you reach the beginning of the next sound; cut the tape here and splice to the end of the piece containing the first sound. Cut and join pieces of the remainder of the sounds.

On replay you will have a series of short sounds each rapidly following the other. Now try a similar exercise but this time insert pieces of blank leader tape between each sound.

MUSIQUE CONCRÊTE

Finally a variation of the two previous exercises. Record a few sounds each at a different tape speed. These should preferably be musical sounds, such as whistles or tones, or sounds produced by tapping a wine glass for example. Cut one or two pieces of each from the tape and assemble them at random with pieces of blank leader between groups. The pieces may be long or short.

Try replaying the assembled tape at different speeds and note the effect. You are well on the way to a form of composition known as "musique concrête" which is the creation of abstract forms of music out of real sounds. The same technique can, however, be used for abstract forms of electronic music in which the main sound source is an audio tone generator.

USING A TONE GENERATOR

The exercises outlined above demonstrate how almost any recorded sound can be altered by tape cutting and by recording and replay at different tape speeds. Electronic music does not normally include natural sounds recorded via a microphone and therefore the sound sources are electronic, i.e., from tone generators of one kind or another. The recording and tape cutting techniques, however, remain the same.

If you have a full range audio signal generator then tones can be recorded at the pitch required. The simple generator described on page 358 has a frequency range of approximately 50 to 2000Hz.

If frequencies outside the range of the generator are required it is simply a case of recording and replaying at different tape speeds for example; if a frequency of around 4000Hz is required, record the highest pitch of the generator (approximately 2000Hz) at a tape speed of 3^{3}_{4} in/sec (inches per second) and replay at 7^{1}_{2} in/sec.

If a very low pulsing sound is required at say 20 to 25Hz record a square-wave signal from the generator at its lowest pitch and then replay the recording at half the speed. Some experiment in this direction will soon reveal the tonal and pitch ranges that can be obtained simply by recording and replaying at various tape speeds.

Once this has been done, further experiment with the audio tone generator can be carried out in order to discover the type of sounds that can be produced. Start by recording a continuous note and while recording this vary the frequency and output controls on the generator, try this for both the square and sawtooth outputs (note that the output in the sawtooth position is much lower than in the square wave position).

Try cutting and reversing the sounds recorded to obtain various effects. You can also try making recordings at a distorted level by turning up the record level control, this will distort the original sound and produce yet another effect. Try switching from one output waveform to the other whilst recording—you can vary frequency and output at the same time—and also try switching the generator on and off while recording, again you can vary the output and frequency whilst turning on and off.

Edit the sounds produced by cutting and splicing and experiment fully with all possible

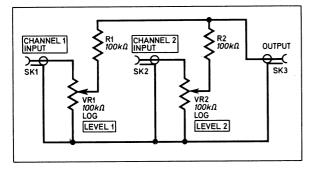


Fig. 3. Circuit diagram of a passive mixer that can be used for making electronic music.

effects. Once you have done this and feel fully conversant with the various effects that the generator is able to produce you can start to add one effect to another.

SIGNAL MIXING

Recording from track-to-track or using two separate tape recorders may necessitate mixing signals that are to be recorded and re-recorded i.e., signals from a recording already made to be mixed with signals from another source such as the tone generator.

Some recorders have built-in mixing facilities whilst others may permit a form of mixing by using the track-to-track recording facility or by superimposing one sound on another previously recorded. Again the tape recorder instruction book will provide information of this nature.

However, it is possible to build a very simple mixing circuit as shown in Fig. 3; Fig. 4 shows the construction. This is known as a passive mixing network, but will alow two signal sources to be mixed at different levels and coupled to a common input on a tape recorder (Fig. 5).

TAPE LOOPS

Another interesting technique widely used for electronic music is the tape loop. This is the use of a small endless loop of tape containing recordings which are played continuously to produce repeating rhythm patterns.

Record a few natural sounds, or low pitched tones from an audio generator, of quite short duration, one immediately after the other. Cut a piece of the tape containing the sounds, about 18 inches long, and splice the ends together so as to form a complete loop. Place the loop in the recorder so that it runs past the tape heads when the machine is set to replay. You can hold the loop under tension by one of the methods shown in the photographs. Try running the loop at different speeds and, if possible, reverse the direction.

Record some percussion sounds, e.g., sounds produced by knocking together empty boxes, etc. Cut out pieces and make up a loop consisting of the various sounds and blank leader tape.

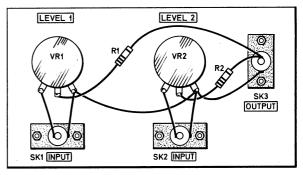


Fig. 4. Constructional details of the circuit shown in Fig. 3. Shop Talk refers to this figure.

For the first attempt use only two or three sounds and two or three pieces of leader.

You can make up an almost endless variety of fascinating rhythm patterns by this method and if you use two tape recorders the rhythm loop can be copied from one to the other whilst other sounds are added.

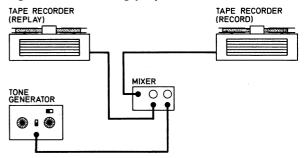
MULTIPLE RECORDING

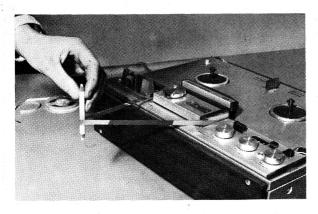
If you have a tape recorder with a track-to-track recording facility the scope is much wider as sounds may be recorded on one track and then re-recorded on to another track whilst adding more sounds. If your tape recorder can produce the echo effect this too can be used in various ways to produce those echoing science fiction sounds. Try allowing the echo to build up into a crashing roar and see if you can play it in reverse.

Now that you have discovered the variety of sounds and rhythms available using the facilities you have it is up to you to put these together to form an interesting "musical" passage. It may take some time before you achieve the required effect.

By combining even a few of the techniques outlined the number of permutations possible are fantastic. Instructions on composition cannot be given because no rules exist. Your ideas must come solely from imagination and experiment.

Fig. 5. Using the passive mixer to combine two signals for recording purposes.









Everyday Electronics, May 1972

The three photographs on the left illustrate various methods of using a tape loop. The top photograph shows a reversed loop held under tension by passing it around a pencil; this is only suitable for short periods.

The centre photograph shows a reversed loop held under tension by a small spool hanging over a table edge; this is only suitable for fairly large

loops.

The lower photograph shows a system that can be used for any size loops by routing the tape around suitable objects—batteries are shown. This photograph also shows a cardboard tape holder used to keep recorded sections of tape in the order required.

COMPETITION

Finally, why not try an entry for the "technical experiment class" of the annual British Tape Recording Contest. It is open to anyone and the closing date for the 1972 contest is not until June 30. The Technical Experiment class allows for tapes of up to 4 minutes duration and includes; sound composition, electronic music, musique concrête, multi-track music and experimental sound recordings. The prizes are worthwhile and you can get an entry form free by writing to The Secretary, British Amateur Tape Recording Contest, 33 Fairlawnes, Maldon Road, Wallington, Surrey, and enclosing a stamped addressed envelope. You may also be interested to know that the special "Tape of the Year" award for 1971 was for an experimental class entry.

Every tape entered is carefully assessed by the expert judges and their comments are passed to the contestant concerned when the tape is returned. Thus you will know how to make an even better tape next time.

PLEASE TAKE NOTE

The approximate cost of components given in the Simple Calculator article last month was incorrectly shown as £1.20. This should have been £2.20.

The probe flying lead in the Signal Injector article (March issue) should be soldered to Y3 not Y2 as stated in the text.

The Normatest 2,000 multi-range test meter mentioned in Shop Talk last month is available from: Croydon Precision Instrument Company, Hampton Road, Croydon, CR9 2RU.



THEY MADE THEIR MARK

NO1 Introduction By J. E. Gregory

ELECTRONICS is an internationally uniform world of symbols. Look at any advertisement or study the simplest circuit diagram in EVERYDAY ELECTRONICS and you will be confronted with strange symbols of every shape. Magical signs used to signify basic units of physical quantity; Table 1 lists some of them.

Although electronics is regarded as a modern science and hobby many of these units are named after pioneers, scattered throughout the world, whose accumulated research spans hundreds of years.

This series sets out to explain the symbol, and perhaps more important something of the man who gave his name to it. But let's begin our potted history of electronics at the beginning.

THE GREEKS HAD A WORD FOR IT

Take the word electronics itself, for that we must go back in time to ancient Greece. To the ladies of Greece passing time by decorating their spinning wheels with amber, found on shores in the far north. They observed that the amber when contacting the threads would draw the threads to itself as they separated from the wool, and then push them away in a frictional force. The

away in a frictional force. The

Greek word for amber was elecktron, from the verb elkein to attract. Although this phenomenon was observed and noted by several of the great Greek philosophers we have to jump two thousand years to the early 1600's and to the reign of Good Queen Bess, who was persuaded by her physician William Gilbert, to attend a demonstration of a frictional electric machine based upon the power of amber to attract. This power he called electricity.

electricity.

It was soon realised that the crackling and sparking of Gilbert's electric machine were the same phenomena on a minute scale, as thunder and lightning, but how to prove it?

THE KITE FLYER

One of the first to try was the fifteenth child of an English immigrant; born in Boston Massachusetts in the year 1706, this was the well known American statesman and philosopher Benjamin Franklin (see illustration above).

His historic but dangerous

experiment trying to capture electricity from the sky occurred during a thunderstorm in the summer of 1752, when accompanied by his small son, he flew a kite with an iron door key. During the storm, he saw that sparks sprang from the key to his wrist, what he didn't realise of course was that if the lightning had actually struck the kite he would have been killed.

The study of natural phenomena had to take second place to his other activities, but he came to the conclusion that thunderstorms were simply the levelling of opposed electrical potentials, between one cloud and another or between a cloud and earth.

It was Franklin who introduced the positive and negative signs for electric charges, realising there are two kinds which neutralise each other.

Next month we move from America to 18th Century Italy and a scientist, Alessandro Volta, after whom the Volt, the measurement of electrical potential is named.

Photograph: Science Museum, London.

Table | FUNDAMENTAL UNITS

unit symbol	name of unit	physical quantity	
* A	Ampere	Electric Current	
V	Volt	Electric Potential	
///F/	Farad	Electric Capacitance	
Ω	Ohm	Electric Resistance	
W	Watt	Power	
Hz	Hertz	Frequency	
H	Henry	Inductance	

These basic units are often inconveniently large or small and the units are prefixed with the following symbols:

100	9		pico	÷ 1,000	,000 million	
1	1	31.4	nano		million	
	_	1.35	micro milli	÷ l mi ÷ l.000		
AND 100 100 100 100 100 100 100 100 100 10	m K		kilo	× 1,000		
	M		mega	× I mil	lion	
	G		giga	× 1,000	million	4.0

Hence 5kV = 5,000 Volts; or 5mV = 0.005 Volt



TEACH-IN

... FOR BEGINNERS

By Mike Hughes M.A.



This year sees the twentieth birthday of the component most responsible for bringing electronics within the scope of do-it-yourself enthusiasts; it has greatly simplified design and construction and has also brought about terrific reductions in costs. It is the "transistor".

As a replacement for the valve, it allows us to use low voltages and removes the arduous task of having to assemble valve bases and massive transformers on tank like chassis. Connections to a transistor are few and the basic way it operates in a circuit is quite easy to understand.

PNP-NPN

The transistor is a member of the semiconductor family and is basically a sandwich of different types of either silicon or germanium. The "filling" of the sandwich can either be p- or n-type material; we can clad a p- type filling with n-type material giving what we call an npn transistor. Alternatively a pnp device is made by filling a p- type material with an n- type.

One encounters both types in practice but nowadays *npn* devices made from silicon predominate, the reason being that they are easier to make and hence cheaper!

Fig. 1(a) shows a diagramatic cross-section of both types of transistor, *pnp* and *npn*. One end is heavily doped and is called the "emitter"; the other end is lightly doped and called the

"collector".

The filling material is very thin in practice (usually one or two microns; 1 micron is a

millionth of a metre) and is called the "base". In its simplest form you can think of an *npn* device as two diodes connected together by their anodes (back-to-back), and facing each other in a *pnp* device, Fig. 1(b).

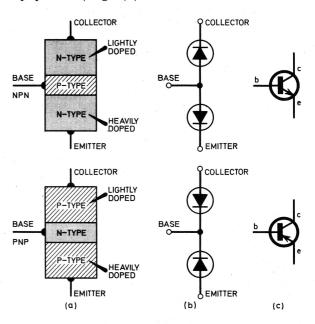
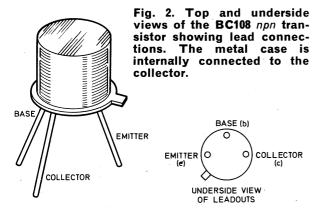


Fig. 1. (a) Schematic diagram of the internal make-up (b) equivalent representation and (c) circuit symbol for (top) npn transistor and (bottom) pnp transistor.

BASE CONNECTIONS

All the transistors you will come across have connections brought out from the emitter, base and collector. A very common silicon *npn* device is the BC108 and we shall be referring to this frequently in this series.

Fig. 2 shows what it looks like. If you have one handy see if you can identify which lead is which.



The emitter is the one closest to the spigot on the side of the can, the collector is diametrically opposite, and the base is between the two but set off to one side. This is a metal can transistor and the can is electrically "live"—in actual fact it is connected to the collector as well as the lead out wire.

Different types of transistor may have different shaped cans and some are in plastic encapsulations. Always make sure you know which lead is which before you start using a transistor.

Most constructional projects in EVERYDAY ELECTRONICS give you lead designations for the transistors specified, but if you want to experiment with alternative types make sure you know the correct base lead connections.

SIMPLE TEST

Use the BC108 npn transistor to identify the effect of the two diodes connected back-to-back. First of all make an ohmmeter on the Demo Deck. Use a 4.5V battery (not 9V) in series with a 2.2 kilohm resistor and VR2 (5 kilohm). Complete the circuit and set VR2 to give zero ohms at full scale deflection and then connect the leads of your ohmmeter between the base and emitter connections of the transistor—to do this it is best to solder the transistor on to three adjacent pins of the Demo Deck and use crocodile clips on the leads from the meter.

If you connect the meter so that the lead coming directly from the negative terminal of the battery goes to the emitter, the meter needle will move to almost full scale showing there is little resistance in the transistor. Now reverse the leads so that the base is more negative than the emitter—you should see that no current

flows (indicated by meter needle not moving). Thus the base-emitter junction is a diode and follows the same rule that we saw last month.

Now leave the lead on the base and transfer the one from the emitter to the collector—again no current flows but reverse the leads and current flows between the base and collector.

If you connect the leads between the collector and the emitter no current should flow whichever way you have them because in both connections, the current would have to pass through a reverse biased diode.

This simple experiment can be used as a rough and ready test to check if a transistor is likely to be in working order, and provided you remember the rule "make p stand for positive for current to flow" you can use it to identify *npn* and *pnp* transistors.

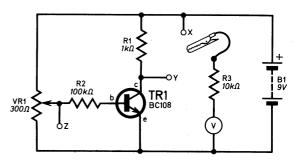
REVERSE VOLTAGE LIMITS

Like all diodes, the junctions of a transistor have reverse voltage limits. These are usually specified with abbreviations. For the BC108 the reverse emitter-base voltage ($V_{\rm ebo}$) is 5V—i.e. you must never make the base more than 5 volts negative with respect to the emitter (this is why we had to use $4\cdot5V$ for our ohmmeter instead of the 9V we have been used to). Likewise the reverse base/collector voltage ($V_{\rm cbo}$) is 30V. You might expect the reverse voltage between the emitter and the collector to be equal to the highest of the other two but this is not the case—it is lower—for the BC108 $V_{\rm ceo}$ is 20V.

The "O" in the suffixes of the reverse voltage characteristics indicates that the third terminal is "open circuit" i.e. not connected.

HOW THE TRANSISTOR WORKS

Let's see what a transistor actually does by using the circuit of Fig. 3(a). Now that we are using the transistor in a real circuit it is important to note the polarity of the supply voltage—for an *npn* transistor the collector must always be kept more positive than the emitter (the converse applies to *pnp* devices). We are going to make the transistor work like a tap and control the amount of current flowing through R1. You can see this happening if you follow the details through on the Demo Deck.



VR1 is a 300 ohm potentiometer working as a potential divider giving us a variable supply at its wiper.

Wire up the circuit of Fig. 3(a) on the Demo Deck as shown in Fig. 3(b), but do not connect R2 to the base of the transistor just yet.

Resistor R3 and the 1mA meter makes a 10V range voltmeter in the usual way. Connect the negative lead to the emitter of the transistor. All voltages we measure will be relative to that of the emitter.

First measure the power rail at point X—it should, of course, be +9V; now measure the potential at the collector of the transistor (point Y) it should be $+8\cdot 2V$. This is what is expected because no current can flow through the back-to-back diodes of the transistor, but the meter will draw some! If you had a high sensitivity meter (say 20 kilohm per volt) this current would be negligible and you would see +9V at both points, X and Y.

Now set VR1 so that the potential on its wiper is zero (with respect to the emitter) and connect R2 to the base of the transistor. VR1 potential is measured by attaching the crocodile clip from the meter to point Z. Again measure the potential at the collector—it should not have changed.

We shall now see what happens if we increase the potential at the wiper of VR1. Do this in 0.5V increments (use crocodile clip at point Z) and for each setting measure the collector potential. You should see that once the potential of the wiper exceeds 600mV, the potential at the collector falls, and continues to fall towards zero as the controlling voltage is increased. Once the collector potential reaches almost zero no more

control can be effected. We say that the transistor is now fully conducting between collector and emitter. This state is called "saturation."

Record your results and plot a graph of collector voltage versus voltage at the wiper. A graph should be obtained similar to that of Fig. 4.

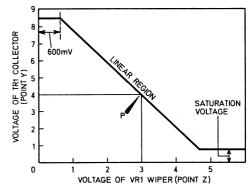


Fig. 4. The graph obtained by plotting the recorded results of experiment using circuit of Fig. 3(a), i.e. voltage at point Y versus voltage at point Z.

Control of the collector/emitter current is brought about by passing a current through the forward biased base/emitter junction. The more current we pass into the base in this way, the more current we can control between the collector and the emitter. The controlling current is called "base current," (I_b) and the controlled current "collector current," (I_c) .

Base current is set by the potential difference between the wiper of VR1 and the emitter of the transistor, acting through the resistance R2

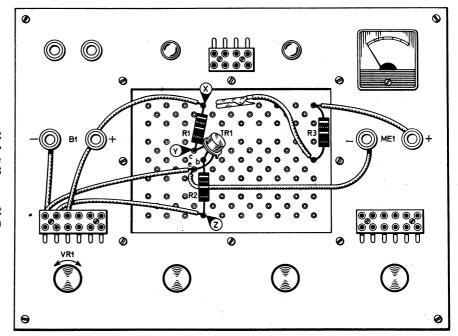


Fig. 3(a) (left). The circuit diagram used for investigating some of the properties of a BC108 transistor.

Fig. 3(b) right. The circuit of Fig. 3(a) wired up on the Demo Deck.

and any internal resistance between base and emitter. The latter is small and can be neglected at this stage. We must, remember, however, that the base must be made at least 600mV positive with respect to the emitter before any current can flow (this is the usual forward voltage drop for any silicon junction).

We can thus calculate the current flowing into the base by measuring the potential at the wiper of VR1, subtracting the base emitter forward voltage drop (600mV) and dividing by the value of R2.

GAIN

If you do this for your experiment you will find that the base current ranges from 0 to 0.084mA. The range of collector current we are controlling was from 0 to 9mA. It can be seen that the transistor enables us to use a very small current to control a larger one. We call this effect "current amplification." The factor that governs the ratio between I_b and I_c is called "gain" and although it increases with I_c it is pretty well constant for any given transistor. It can, however, vary widely between different types of transistor and even between devices having the same type number! Provided you take a combination of base and collector currents within the controllable region (this is called "linear region") you can calculate the gain of the transistor you are using.

It would be best to increase the potential at VR1 until the collector potential is approximately 4V. This reduces the shunting effect of our voltmeter.

Use the precise values of voltage measured to calculate the current through R2 and R1 then use the ratio of these values to calculate the gain.

gain = collector current \div base current = $I_c \div I_b$

For the BC108 transistor it should be approximately 200, but as we have said, will vary from device to device.

Example To calculate the gain from your plotted curve (similar to the one of Fig. 4) select a convenient point on the linear region such as point *P* of Fig. 4.

The base current, I_b is given by the voltage difference between the base and emitter divided by the base resistor.

i.e.
$$\frac{3-0.6}{100.000} = 0.024$$
mA

Now the voltage drop across the collector resistor R1 is (9-4)V=5V. Therefore, collector current I_c is $(5 \div 1000)=5$ mA.

Substituting these values for I_c and I_b in equation (1) gives the gain = (5-0.024) = 208.

There are various ways of describing current gain for a transistor so we shall define that measured above a little more precisely—it was the d.c. current gain. This is sometimes abbre-

viated to the designations β (beta) or $h_{\rm FE}$. The latter is rather a strange type of designation but is one of a range of what are called "h" parameters—we need not worry ourselves about these in this series except for the term $h_{\rm FE}$ which is usually used in manufacturer's data sheets. Do not confuse $h_{\rm FE}$ with $h_{\rm fe}$, the latter is called the small signal current gain and we shall not be dealing with this until later.

The gain equation above can be rewritten: $I_c = h_{FE} \times I_b$

Remember that the experiment we have just done has been using a silicon npn device. We could have used one made from germanium having npn structure and obtained a similar effect—except that the base/emitter forward voltage drop would have been only about 200mV and $h_{\rm FE}$, in general, would have been lower.

We could also have used a silicon or germanium pnp device but would have had to reverse the battery connections so that the collector was negative with respect to the emitter. The same rules would have applied and we could have still calculated a value for $h_{\rm FE}$.

If you are a little confused by the difference between npn and pnp devices do not worry too much as this stage—most of the early experiments in Teach-In will use npn devices and when you have got used to these you will find it quite straightforward to switch over to pnp devices when necessary. The most important thing to remember is the polarity of battery voltage when using one type or the other. An aid to remembering what the polarity ought to be is to bear in mind the direction of conventional current flow;

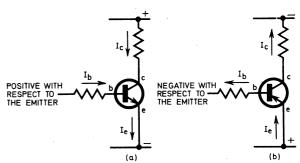


Fig. 5. Circuits showing major current flow directions for (a) npn and (b) pnp transistor. I_b —base current, I_c —collector current, I_c —emitter current.

the arrow on the emitter of the symbol points in the direction of current flow, i.e. it points away from positive and towards negative. See Fig. 5.

Whether using npn or pnp devices an aid to remembering how to turn collector/emitter current "on", is to make the potential at the end of the resistor connected to the base tend towards the same polarity voltage as applied to the collector; the more you move towards this voltage, the more I_b increases, and I_c will increase in direct proportion.

When the potential feeding the base rises towards the supply voltage the voltage at the collector falls towards the emitter voltage. This is called "inversion."

In Fig. 3 R1 is called the "collector load." The limit of I_c control is set by the value of this resistor; if it has a high value then it does not matter how much base current you apply, you cannot control more collector current than that given by the collector supply voltage divided by the value of collector load. On the other hand, if the load is too low you might find yourself trying to force more collector current than the construction of the transistor can handle. Thus one of the specifications of a transistor is the maximum collector current it can handle without "blowing". This is called $I_{\rm cmax}$ and for the BC108 is $100\,{\rm mA}$.

A final parameter we must deal with is the power rating of a transistor. As current is passing through it a certain amount of heat is dissipated. We already know that too much heat can spoil the properties of a semiconductor so it must be limited. The limit is set by the maximum power dissipation parameter, $P_{\rm cmax}$. It is easy to calculate what the power dissipation is likely to be; it is the dissipation you would get if you replaced the transistor in the circuit with a resistor having the same ohmic value as the collector load.

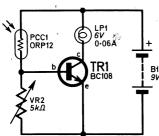
Table 1 gives you some typical values of parameters for some common transistors of varying types, powers and polarities.

Table 1: THE MORE IMPORTANT CHARACTERISTICS OF SOME COMMON TRANSISTORS

Type	Polari	ty P _{c max}	V_{cbo}	V_{ceo}	V_{ebo}	c max	h _{FE}
BC108	. nþn	300mW	30V	20V	5V	100mA	240
2N292	6 npn	200mW	18V	18V	5V	100mA	150
BFY51	npn	800mW	60V	60V	6V	IA	70
BFX13	þnþ	300mW	-20V	-15V	5V	I00mA	120
2N370	2 pnp	360mW	-40V	25V	-5V	200mA	60
ACI26	þnþ	500mW	-32V	32V	-10V	I00mA	100
OC72	þnþ	125mW	-16V	-16V	-3V	125mA	50
OC26	· þnþ	12W	— I6V	-16V	IOV	3.5A	50
OC36	рпр	30W	-80V	-32V	-40V	IOA	70

Fig. 6(a) (below). The circuit diagram of the "Electronic Candle" which illustrates positive feedback.

Fig. 6(b) (right). The circuit of Fig. 6(a) wired up on the Demo Deck. Ensure that PCC1 is close to LP1.



ELECTRONIC CANDLE EXPERIMENT

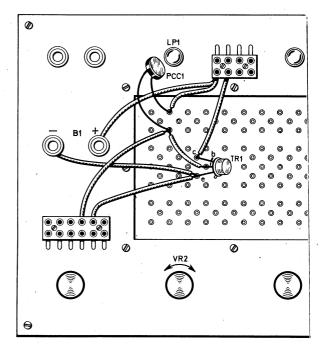
We shall now make a simple working circuit using the circuit diagram of Fig. 6(a). This is wired up on the Demo Deck as shown in Fig. 6(b). Connect the ORP12 (light dependent resistor) very close to the LP1 on the Demo Deck as shown below. Set VR2 to zero ohms. The potential at the base of TR1 will be zero, therefore no current will flow between collector and emitter. Now, in a reasonably lit room, increase the value of VR2. At a certain point the potential at the base will reach 0.6V (set by the potential dividing effect of PCC1 and VR2) and the transistor will start to conduct (the bulb will glow dimly).

Continue to increase the resistance of VR2; the current flowing through PCC1 will now pass into the base/emitter circuit of the transistor in preference to the higher resistance path through VR2. This base current will cause TR1 to pass more collector current until the bulb is fully illuminated.

When you reach this point (the minimum value of VR2 that will give full illumination) try casting a shadow over PCC1, the lamp will go dim and ultimately go out altogether as I_b reduces due to the resistance of PCC1. We did a similar sort of thing in Teach-In Part 4.

The difference is that we now have a circuit that is much more sensitive to small changes in light level which is brought about by the transistor amplifying the current from the photo resistive cell.

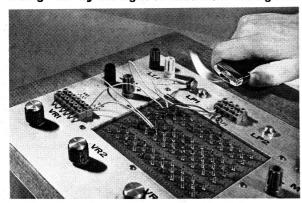
If you place the cell very close to the bulb in a dimly lit room you can set the value of VR2 so that the ambient lighting does not turn the transistor on, but the light from the bulb will.



Break the light path between the bulb and the cell and the bulb goes out and stays out. Now use a match or lighter to provide a stimulus of light. Bring it close to the bulb/cell assembly and the bulb lights up; you can now remove the match and the bulb will stay on because its own light output is holding the transistor on. This is called "positive feedback" and in this circuit will provide an amusing party trick—especially if assembled to look like a candle.

A bit of practice at "snuffing" the candle with the fingers (actually you are breaking the light path between the bulb and the cell) will make the effect even more astounding.

Photograph of the Demo Deck set up for the Electronic Candle Experiment showing the lamp being "lit" by the light emitted from the lighter.



TEACH-IN PART 6—ERRATA

Fig. 4(b) last month shows a lead connected wrongly. The lead from the junction of R3 and the negative meter terminal should go to the negative end of VR1 (not the wiper as shown) i.e. the one connected to the battery negative.



Next month: Multivibrators. The components needed for next month in addition to those already acquired are: resistors 22 kilohm (2 off), 100 ohm (1 off); capacitors $0 \cdot l \mu F$ polyester (2 off), $500 \mu F$ elect. 12V (1 off); transistors BC108 (1 off); diodes OA91 (1 off).

Ruminations By Sensor

Not so Clever

The coal miners' strike has shown how dependent we are, in this age of high technology, on the efforts of men who work in damp, dirty and often dangerous conditions.

I find it difficult to comprehend that on one hand the semiconductor industry owes its existence to the ability to obtain and to process materials with an impurity content of less than ten parts in a thousand million, and to operate with tolerances down to one millionth of a metre, while on the other hand men have still to dig fossil trees out of the earth (albeit with mechanical assistance) so that these fossilised remains can be burnt to boil water in order to raise steam

and to generate electricity! Without coal and electricity there would be no semiconductor industry; truly our idol has feet of clay!

Let There be Light

Have you heard about the old lady who telephoned the C.E.G.B. to complain that, during the power cut, the buses were passing her house with all their lights on? She also said that she could manage to get along quite well without the electricity, except for the little light in the hall, and could they please leave that one switched on.

Many people must have been irritated, in the early days of the strike, to see street lights blazing all day and switched off at night, due to their electric clock switch mechanisms getting umpteen hours behind. To the electronics man the answer to this problem is so simple—a light operated switch, either using discrete components or in integrated form.

A recently introduced inte-

grated circuit provides the necessary photo cell, level sensor and time delay all on one tiny chip of silicon and complete with lens. It could operate a relay or, better still, work into a switching transistor controlling the street lamp directly.

Some years ago, I was shown around a large generating station, where, tucked away in a dusty corner there was a cast iron box about the size of a domestic cooker. This apparatus was installed at the station about twenty five years ago and its purpose was to switch on all the electric street lamps in the town.

When switched on it produced a ripple which was superimposed on the mains. Sections of street lighting were grouped together under the control of master switches, spread throughout the town, which were operated by switching on the ripple equipment. The system had been in use but for some reason, unknown to my guide, had been discontinued. It would have been a blessing during February 1972.

Everyday Electronics, May 1972



Multimeter

Probably the most useful of all test equipment is a multimeter and next month we show you how to build a fairly simple one that will meet the needs of most constructors.

Light to Sound Converter

A project for those who like to experiment. This unit produces an audio tone, the frequency of which is dependent on the light level sensed by a photocell.

AISO...

A new feature for all

beginners and constructors... GUIDE TO CIRCUIT SYMBOLS

A new feature for all beginners and constructors; Guide To Circuit Symbols. We explain the symbols and show you what the components look like. Starting next month.

On sale Friday, May 19



M ODERN research calls for accurate measurement and comparisons, and with this in mind this device was designed to help the beekeeper assess the performance of his beehives more definitely, and to compare the different strains of bees under the same working conditions and so help to breed a strain which will produce the most honey under all the difficulties encountered in our changing climate without the rather nasty habit of the English bee, of attacking the bee-keeper as soon as he appears anywhere near the hive.



The Bee Counter is an instrument which records the number of bees entering the hive, and used in conjunction with other devices such as a wind speed indicator, a wind direction indicator, an air temperature thermometer, a maximum/minimum thermometer, a rain gauge and a sunshine recorder, then some degree of assessment can be made, and some basis established for the bee-breeder to work upon his main goal—lots of honey from a reasonably good tempered, busier bee.

The Bee Counter makes use of the fact that bees are highly organised in their habits, and utilises the bees sense of sight and smell. These bee "characteristics" are used in the design of the cabinet housing all the circuitry which is described later in full detail.

THE CIRCUIT

The complete circuit diagram of the counter is shown in Fig. 1 and is basically an amplifier which works as follows.

The lamp LPI, which is always "alight" when

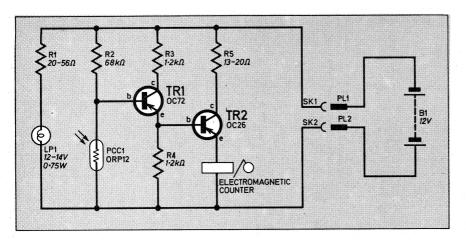


Fig. 1. The complete circuit circuit diagram of the Bee Counter.

the unit is switched on, illuminates the light dependent resistor, PCC1, and causes its resistance to be at a low value, about 100 ohms.

The l.d.r. and R2 form a potential divider circuit and under "illuminated conditions" of the l.d.r., a positive voltage with respect to the emitter, is applied to the base of TR1 causing it to be in a conducting state.

With TR1 conducting, a negative voltage is applied to TR2 base with respect to the emitter and consequently TR2 is "off" (not conducting).

When the light path between LP1 and PCC1 is broken, the resistance of PCC1 increases considerably (to about 100 kilohm for complete "blackout"). This causes the potential at TR1 base to go negative and turns it "off". This state of TR1 causes the voltage applied to the base of TR2 to go more positive and causes it to switch "on" i.e. conduct—current flows through TR2.

When current flows through the emitter leg of TR2 containing the relay coil in the counter, the relay is energised.

When the light to PCC1 is restored, TR2 switches "off" and the counter is de-energised and springs back to its off position and in doing so mechanically adds "one" to the counter readout.

The arrangement of LP1 and PCC1 in the case is so devised that the bee, on entering the hive, breaks the light path between these devices and its entry is thus recorded.

The 13-20 ohm 3 watt resistor, R5, in the collector circuit of the power transistor, TR2, is to prevent damage to the counter or the transistor if the entrance passage to the hive should become blocked, as once happened in the prototype when a drone got stuck in the narrow part.

A heavy duty battery is required to operate the Bee Counter since current drain is substantial —250 mA when TR2 is "off" and 400 mA when TR2 is "on" at 12V. A car battery is therefore recommended to supply the power. The cost of this battery is not included in approximate cost.

The voltage is fairly critical as it must be sufficient to operate the counter, but not high

Components....

Resistors

R1 20-56\(\Omega\) 3 watt

 $\text{R2}\quad \text{68k}\Omega$

R3 1·2kΩ

R4 $1 \cdot 2k\Omega$

 $\textbf{R5} \quad \textbf{13-20}\Omega \; \textbf{3} \; \text{watt}$

All $\frac{1}{2}$ watt carbon $\stackrel{...}{=}$ 10% unless otherwise stated

Transistors

TR1 OC72 (or similar) germanium pnp TR2 OC26 germanium pnp

Light Dependent Resistor

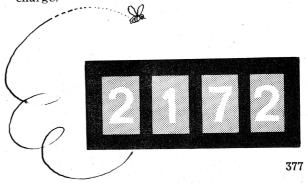
PCCI ORP12

Micellaneous

LP1 12-14V 0.75W bulb and holder PL1, PL2 Wander plugs, 1 red 1 black (2 off) SK1, SK2 Sockets to suit plugs PL1, PL2 B1 12V battery—heavy duty rechargeable type (Not accounted for in cost box.) Counter: Post Office type 14C 4·2Ω 4 figure readout. Cedar wood, Perspex and adhesive, Paxolin, wood screws, 4 B.A. nut and bolt, wood glue.

enough to cause overheating of TR2 or the counter coil in the event of the passage being blocked for long.

If the apparatus is disconnected every night the battery will last at least a week on one charge.



Everyday Electronics, May 1972

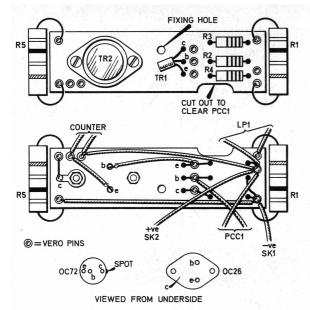


Fig. 2. The layout of the components on both sides of the Paxolin board. Veropins are used for attachment.

Variations in performance can be dealt with in several ways. The lamp should be bright enough to turn off the amplifier, but not any brighter than necessary. This is best adjusted by altering the series resistor R1, which may be increased to as high as 56 ohms.

Also, the size of the light hole can be varied, or a part of the l.d.r. painted over so that it has less area exposed, until the instrument is sufficiently sensitive, but positive in its action.

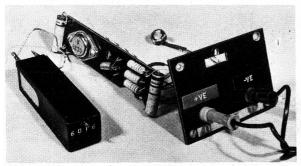
THE COUNTER

The electromagnetic counter used is a Post Office type. It has a four digit readout and can thus count up to 9,999. The maximum count rate is ten per second.

COMPONENT WIRING

Most of the components of Fig. 1 are mounted on a piece of Paxolin size $4^{1}_{2} \times 1^{1}_{4}$ inches with a cut-out as shown along one side to accommodate the light dependent resistor, PCC1.

Both sides of the board containing the components are shown in Fig. 2.



Veropins are used for mounting the components in position and small holes should be drilled where indicated to accommodate these pins.

Three more small holes of the same size should be drilled to take the leads of TR1 as shown.

Drill the component board fixing hole and the four holes for transistor TR2; (see reverse side of component board Fig. 2); ¹8in. diameter holes will do for all five holes.

Begin assembly by pushing in all the Veropins and then attach TR2 to the board using two small nuts and bolts.

The connection to the collector of TR2 is via its casing, so a solder tag should be attached to one of the securing bolts to enable this connection.

Attach and solder all the components, link wires and flying leads as detailed in Fig. 2 making sure a heat shunt is used when soldering in TR1, which incidently should be the last component connected.

The l.d.r. should be attached to the board via 6in. long flexible leads.

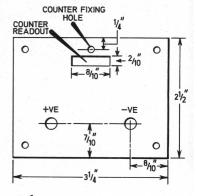
The flying leads to the counter should be about 4in. long.

The two wander sockets used for battery connection to the counter, are attached to the end of the case which is made from a piece of Paxolin, dimensions are given in Fig. 3.

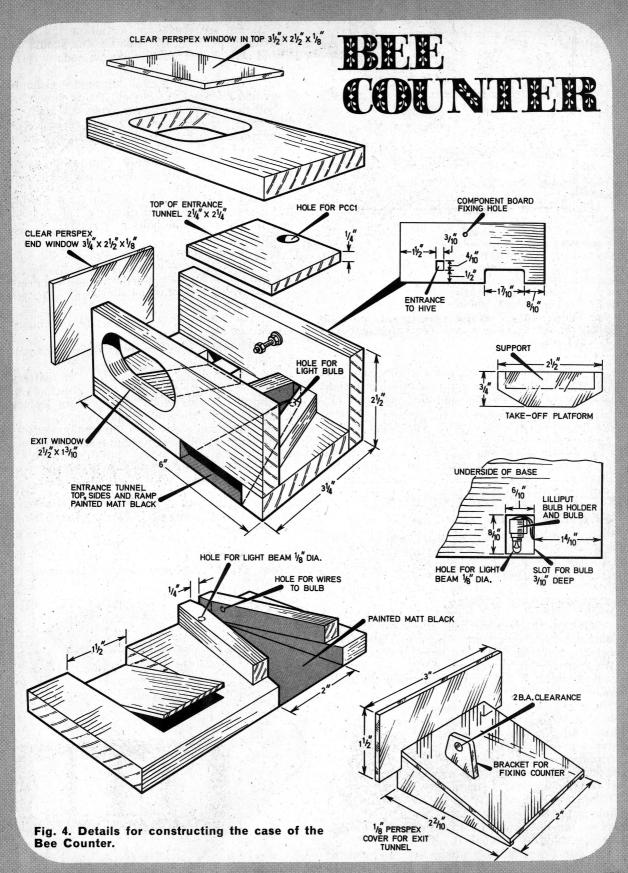
The connection wires from the wander sockets to the component board should be about 4in. long.

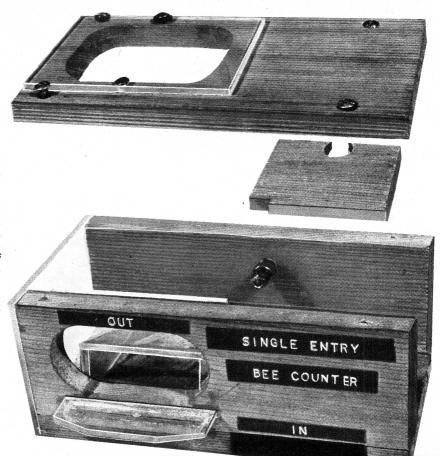
Connection to the battery is made via two wander plugs and a length of twin flex.

Fig. 3. Dimensions of the end made from Paxolin to accommodate the wander sockets for battery connection, and counterreadout.









A photograph of the prototype with top and tunnel lid (which holds PCC1 in position) removed. The photograph clearly shows the entrance and exit tunnels (labelled IN and OUT respectively). The take-off platform, made from Perspex, is located just beneath the exit cut-out, and is glued in position with Perspex adhesive.

EXIT AND ENTRANCE GEOMETRY

As said before, this device and its design utilises the bees' senses of smell and sight. From inside the hive, the exit from the hive appears as a bright opening to the outside world and so the exit path through the instrument must be a tunnel with transparent sides and top to allow this condition to be fulfilled.

In the instrument this tunnel slopes upwards so that when the bee emerges, it finds itself on a platform of Perspex, about ³4in. wide, situated above the hive base, and flies away.

When it returns, it will land on the hive base (landing/alighting board) and walk towards the hive.

The entrance to the hive is now through the Bee Counter which is a tunnel painted matt black; when the bee walks along the front of the instrument and reaches this tunnel it will enter.

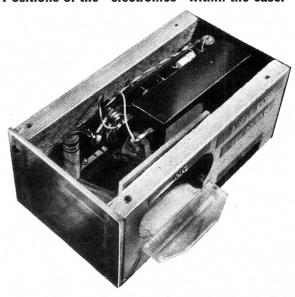
On entering, the tunnel becomes narrower and at the same time slopes upwards until it is just wide enough for a single bee to pass.

There is a lamp under the narrow part, with a hole in the floor of the tunnel, made up to the level of the floor with Perspex cement so that light can shine up through it.

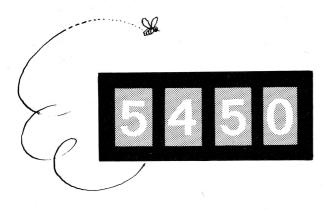
The light dependent resistor is situated in the

roof of the tunnel and as the bee walks between this and the lamp, the light beam is cut and the circuit activated.

Positions of the "electronics" within the case.



Everyday Electronics, May 1972



CONSTRUCTION OF CASE

Cedar wood should be used to construct the case as this material will be readily acceptable to the bees.

Cedar wood will also withstand the weather without the need for painting but it is well to remember that if the counter is to be used in exposed outdoor conditions, weather protection becomes an important consideration, whereas in laboratory conditions it is not so.

The best compromise for an outdoor installation is a shelter which will keep off the rain.

First of all make all the wooden parts of the case as detailed in Fig. 4.

Now solder the two thin flexible covered wires to the bulb holder tags and screw in the bulb. These wires are led out through the top of the base and the bulb assembly is glued in position.

It is not likely that the bulb will need replacement because it is "under run" and there is a 20 ohm resistor (R1) in series with the bulb which reduces the light and heat dissipated in the bulb.

When the glue has set, fill up the light hole with Perspex cement so that it comes flush with the passage floor.

Glue down the two sides of the tunnel so that the width of the narrowest region is $^{1}_{4}$ in. Paint the tunnel top, bottom and sides a matt black.

The light dependent resistor should be a push fit into a hole in the tunnel roof.

Glue and screw the front and back to the base and glue the exit ramp in position. Drop the tunnel roof into position indicated. The other parts of the case are made from Perspex and their dimensions are given in Fig. 4.

With these made we can proceed with the assembly.

ASSEMBLY

Begin by screwing the Perspex side and top windows in position as indicated. Glue the Perspex platform to the front and place the Perspex exit guide in position.

Now solder the two wires from the bulb holder to the component board as detailed in Fig. 2, push the l.d.r. in position and then attach the board to the back of the case by means of a 4 B.A. nut and bolt. This bolt should be countersunk into the back so the back is flush with the front of the hive. If there is a gap here, the bees will try to go in or out through the smallest crevice.

Attach the wander sockets to the Paxolin side and solder to the appropriate flying leads from the component board. Next screw the Paxolin side to the case.

When the flying leads to the counter have been connected, fit the counter into its locating holes, (one end in the Paxolin and the other in the bracket on top of the Perspex exit guide) and secure with nuts. The counter digits should be visible through the slot in the Paxolin side.

Screw the top on and the unit is complete.

CAPACITY AND POSITION OF CASE

The single entry counter (as this is) is only suitable for a three or four frame hive, since with a full scale hive the returning bees would sometimes overload the tunnel capacity.

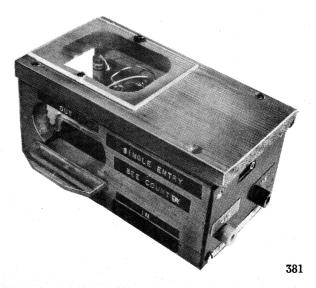
The maximum a single entry counter can handle is about 60 per minute.

For a full scale hive a three entry counter is necessary. This means the entry tunnel is divided into three passages, each with its own light beam arrangement, amplifier and counter.

Whereas the single entry model is only 6¹4in. wide, which is about right for most observation hives, it is better to make the three entry model 16¹2in. wide so that it takes up the whole width of a Standard National hive.

When the counter is put in front of the hive the hive should be moved back by a distance equal to the depth of the Bee Counter, in this case 314 in. so that the point of entry is exactly as it was without the counter.

When this is done the bees will soon get used to the new conditions and will be using the exit and entry passages without any confusion.



Everyday Electronics, May 1972



LOGATOB

to remove unwanted a.c. from the voltmeter input, and diodes D1 and D2 protect the meter movement against overload.

At a certain setting of C4, the d.c. voltage at TR1 emitter will equal the voltage at the junction of R5 and R6 so that no current flows through ME1; this can be taken as the normal operating point for the circuit. If metal is brought close to L1, the emitter voltage of TR1 will rise by several millivolts in relation to the voltage at the junction of R5 and R6, and the meter will read.

Full scale sensitivity of the null voltmeter is around 150 millivolts. Metal Locator response is shown in Fig. 2, where meter reading is plotted against depth for three weights of metal.

CONSTRUCTION

Commence construction by cutting a piece of $0\cdot 1$ inch matrix plain perforated circuit board to a size of $3\cdot 1$ by $1\cdot 4$ inches, and drill holes to take C4, VR1, and S1 (see Fig. 3).

Cut two brackets from a length of $^{1}2$ inch aluminium angle and drill to accept the meter terminal screws and 6B.A. circuit board mounting screws.

Bolt the brackets to the circuit board, complete with solder tags, and insert all terminal pins in the positions shown in Fig. 3.

With C4, VR1, and S1 in place on the circuit board, proceed to mount and solder the remaining components in the following order; resistors, capacitors, wire links and leads, diodes and the transistor, using a heat shunt to protect the diodes and transistors while soldering them.

Obtain a plastic beaker with lid (of minimum dimensions 5 inches high by 2^{1}_{2} inches diameter) and cut away the centre of the lid to accept the meter MEI. Next, drill holes in the beaker for L1 leads, woodscrews, and to allow access to the circuit board controls, see Fig. 4.

When following the step-by-step instructions in Fig. 5, for making up the search coil L1, ensure that the pile windings can slide easily off the 5 inch diameter former. Short strips of insulating tape, placed sticky side out around the former, will hold the turns together and facilitate removal of the coil. Do not use Sellotape for this purpose as it is likely to damage the wire.

The metal locator frame (Fig. 4 and 6) consists of a chipboard or plywood handle, a ⁵₈ inch diameter dowel pole, and two s.r.b.p. or Perspex sheets for the search head. Screw and glue the handle to the pole and then glue the other end of the pole to the search head top board, this assembly can then be painted.

To complete the construction, screw the

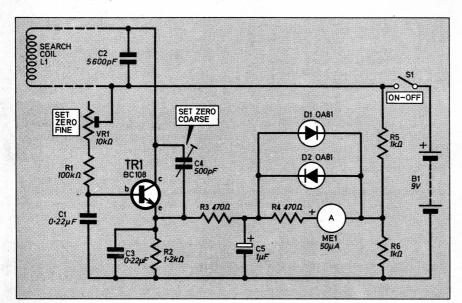


Fig. 1. Circuit diagram of the Metal Locator. The search coil L1 is mounted in the locator head and the dotted lines are the connecting wires to the circuitry.

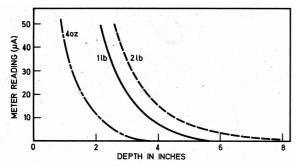


Fig. 2. Response curves of the Metal Locator.

plastic beaker to the pole opposite the handle, securely clamp the search coil between the boards, run twin leads from L1 to the beaker, and position the battery.

In the prototype, the battery was held in place behind the meter with a rubber band, as shown in the photograph, but it could equally well be fixed inside the beaker with a small clip or elastic band.

SETTING UP

Adjust VR1 to mid track, C4 to minimum capacitance (unscrewed), and switch on. The meter pointer should go beyond full scale. With the search coil well away from metal objects, screw in C4 until the meter reads somewhere between zero and full scale. Trim for a zero reading with VR1.

OPERATING LICENCE

The Metal Locator described in this article is designed to operate in the frequency band specified by the Ministry of Post and Telecommunications (16 to 150kHz). The circuit design of the locator should not be altered in any way that may affect the operating frequency.

A licence must be obtained before using the locator; this costs 75p for 5 years. An application form for a licence is obtainable from the Ministry of Post and Telecommunications, Waterloo Bridge House, Waterloo Road, London, S.E.1.

If the meter fails to read, or no response is obtained from adjustment of C4, check for wiring errors.

A certain amount of drift will be evident immediately after the locator has been switched on, therefore allow the circuit to settle down and then readjust C4 and VR1. Locator response can then be checked with metal weights and compared with Fig. 2.

Increased sensitivity can be achieved by reducing the value of C3 to 0·15/F, but this will enhance circuit drift to the point where frequent adjustment of VR1 is necessary. Conversely, drift and sensitivity will be reduced if C3 is increased in value.

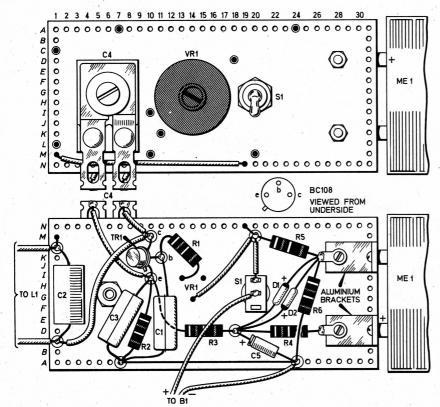
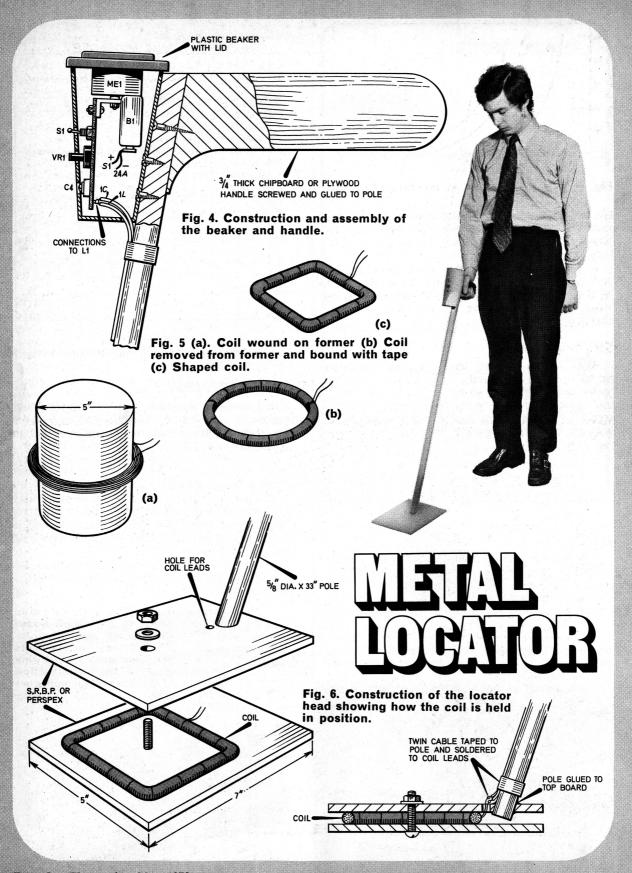


Fig. 3. Top and underside views of the circuit board and meter assembly. The circled connections represent the terminal pins used in the construction of this item. These pins are clearly indicated in the top diagram.



Components....

Resistors

R1 $100k\Omega$ R2 $1 \cdot 2k\Omega$

R3 470Ω

R4 470Ω

R5 $1k\Omega$

 $R6 1k\Omega$

All \pm 10% $\frac{1}{2}$ watt carbon.

Capacitors

C1 0.22 µF polyester 250V

C2 5,600pF polystyrene

C3 0.22µF polyester 250V

C4 500pF mica compression trimmer

C5 1μ F elect. 12V

Semiconductors

TR1 BC108 silicon npn

D1 OA81

D2 OA81

Meter

ME1 $50\mu A$ f.s.d. moving coil. SEW type

MR 38P

Switch

S1 S.P.S.T. sub-miniature toggle

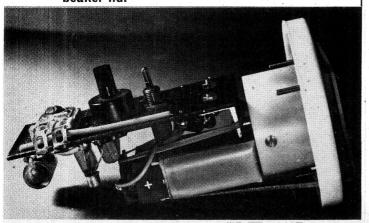
Miscellaneous

VR1 10k Ω miniature carbon T.V. type preset B1 PP3 battery. Circuit board 3.1 inch by 1.4 inch plain, perforated 0.1 inch matrix Veroboard and Veropins. 26 s.w.g. cotton covered or enamelled copper wire, plastic beaker (see text), connecting wire, wood and screws for assembly, $\frac{1}{2}$ in aluminium angle for brackets.

USE

The locator is now ready for use and can be used for beachcombing or searching the back garden or waste ground. The locator may be subjected to damp and the pole, in particular, should be painted for protection if nothing else.

Photograph showing the construction of the circuit board and meter mounted on the beaker lid.



Continued from page 361

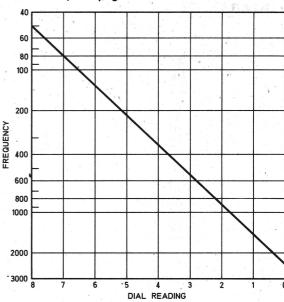


Fig. 8. Approximate output frequency for various control settings.

FINAL ASSEMBLY

Final assembly amounts to attaching the front panel to the box frame with self tapping screws, fitting the battery inside and fitting rear panel.

The generator can be connected to the input of any amplifier but the signal output level should be adjusted in accordance with that required by the amplifier input. To comply with the calibration chart given in Fig. 8 turn VR1 fully anti-clockwise and fix the frequency control knob to read zero. The output control knob is fixed in the same way i.e., to read zero with VR2 fully anti-clockwise.

The Audio Tone Generator is now ready for use and can be tried out in conjunction with a tape recorder.



Everyday Electronics, May 1972

LARGEST SELECTION OF SEMICONDUCTORS BRAND NEW COMPONENTS **GUARANTEED TRANSISTORS** 2N3404 2N3405 2N3414 2N3416 2N3416 2N3570 2N3570 2N3605 2N3606 2N3607 2N3702 2N3703 45p BC212L 35p BCY30 47p BCY31 37p BCY32 47p BCY33 NKT281 NKT401 NKT402 NKT403 NKT404 NKT405 40310 40311 40312 32½p 82½p 62½p 22½p 27½p 27½p 27½p 2G301 2G302 2G303 BSX28 BSX60 27½p 87½p 90p 75p BC212I BCY30 BCY31 BCY32 BCY33 BCY34 BSX61 BSX76 BSX77 BSX78 2G306 22 tp 30p 30p 15p 20p 22ip 22ip 2G308 40320 201300 40323 2G309 2G371 2G374 2G381 2N404 2N696 2N697 40324 40326 BSY10 BSY11 NKT406 NKT451 NKT452 BCY38 BCY39 BCY40 BCY42 BCY43 BCY54 BCY59 BCY59 BCY70 27½p 15p 15p 17½p 17½p 17½p 25p 25p 25p 40326 40329 40344 40347 40348 40360 40361 BSV24 BSY24 BSY25 BSY26 BSY27 BSY28 BSY29 BSY32 BSY36 BSY37 NKT452 624p NKT453 474p NKT603F824p NKT613F324p NKT674F 30p NKT677F 30p NKT713 25p NKT713 30n 20p 17p 2N698 2N698 2N706 2N705A 2N708 2N709 2N718 2N726 40362 40362 40370 40406 40407 40408 40410 40467A NKT781 30p NKT10419 30p BCY71 BCY72 BCZ10 BCZ11 NKT10439 371p NKT10519 2N727 32½p NKT20329 47½p NKT20339 2N727 2N914 2N916 2N918 2N929 2N930 BD116 BD121 40467A 40468A 40600 AC 107 AC126 AC127 AC128 AC154 AC176 BSY52 BSY53 BSY54 35p 571p 30p 20p 25p 20p 221p 25p 871p 40p 90p 471p 45p BSY54 BSY56 BSY78 BSY79 BSY82 BSY90 BSY95A 37<u>1</u>₽ NKT80111 2N1090 2N1091 2N1131 77½p NKT80112 97½p NKT80113 2N1131 2N1132 2N1302 2N1303 2N1304 2N1305 2N1306 25p 62½p 87½p 27½p 25p 25p 25p AC187 AC188 ACY17 ACY18 ACY19 ACY20 ACY21 ACY22 ACY22 ACY40 ACY41 ACY44 AD140 AD150 BSW41 BSW70 421p £1.12 NKT80211 27 p 75 p 221p 221p 25p 25p 30p 30p 171p 25p 35p 30p 271p C111 C424 C425 C426 92½p 92½p NKT80212 92½p NKT80213 92½p NKT80214 92½p NKT80215 27½p 55p 40p 2N1307 25p 20p 20p 20p 25p 25p 52lp 57lp 62lp 25p 25p 25p 25p 62lp 2N1308 2N1309 2N1507 2N1613 2N1631 2N1632 2N1632 25p 47½p 37½p 18p 19p 30p 30p C428 37₁p 30p BF115 BF117 BF163 BF167 BF173 BF177 BF178 C428 C744 D16P1 D16P2 D16P3 D16P4 GET102 GET113 871p 871p 40p 921p NKT80216 2N1639 OC20 OC22 OC23 OC24 OC25 OC26 BF179 BF180 BF181 2N1671B 80p 85p 2N1711 2 22 2N1711 2 22 2N1711 2 22 2N189 3 21 2N199 5 21 2N199 6 21 2N199 6 21 2N199 6 21 2N199 7 30 2N1 AD161 AD162 AF106 AF106 AF116 AF116 AF116 AF117 AF118 AF119 AF124 AF125 AF126 AF127 AF128 AF127 AF138 AF178 GET114 GET114 GET118 GET119 GET120 GET873 GET880 GET887 35p 32½p 25p 42½p 17½p 15p 42½p 42½p BF181 BF184 BF185 BF194 BF196 20p 52ip 12ip 30p 20p 22ip 22ip GET887 GET889 GET896 GET896 GET897 GET898 MJ400 MJ420 MJ420 MJ420 MJ440 MJ480 MJ481 MJ481 MJ481 BF197 BF198 BF290 BF290 BF2925 BF237 BF238 BF244 BFW61 BFX13 BFX13 BFX13 BFX44 BFX45 BFX45 BFX85 BFX86 BFX87 BFX88 BFX87 BFX88 BFX87 BFX88 BFX89 BFX91 BFY11 BFY11 BFY118 BFY118 BFY118 BFY118 BFY118 BFY118 42 p 42 p 52 p 14 p 19 p 23 p 23 p 20p 22ip 20p 20p 17ip 87ip 72ip 72ip 42ip 47ip 47ip 87ip 87ip 87ip 25p 25p 25p 25p 25p 25p 22 i p 221p 25p 66 22±p 7 22±p 88 22±p 81.07± \$1.12± \$1.12± \$1.02± 95p 97±p \$1.26 20p 12½p 15p 15p 12½p 12½p OC44 OC45 OC45 OC46 OC70 OC71 OC72 OC74 OC75 23p 47ip 22ip 22ip 30p 30p 37ip 37ip 32½p 22½p MJ481 \$1.25 MJ490 \$2.00 MJ491 \$1.37 MJ1800 \$2.17 MJE340 62 MJE520 60p MJE521 73p MPF102 42 MPF103 37 MPF103 37 **OC76** OC76 OC77 OC81 OC81D OC83 OC84 OC139 67∮p 25p 2N5174 2N5175 2N5176 2N5176 2N5232A 2N5245 2N5246 2N5249 2N5266 2N5266 2N5266 2N5306 2N5306 2N5307 2N5308 25p 25p 27ip 25p MJE521 78p MPF102 42½p MPF103 37½p MPF104 37½p MPF105 37½p MPS3638 32½p NKT0013 47½p NKT124 42½p NKT125 27½p OC140 OC170 OC170 OC171 OC200 OC201 OC202 OC203 OC204 621p 70p 32½p 32 ± p £1 ⋅ 25 42½p 22½p 32½p 32½p 32½p 410 42½p 45p 25p 50p 50p 50p 52½p 23p 23p 42 ip 10p 10p 10p 10p 15p NKT126 NKT128 OC205 OC207 NKT128 NKT135 NKT137 NKT210 NKT211 NKT212 NKT213 2N2904A 32½p 2N2905\ 37½p 2N2905A 40p 2N2906A 25p 2N2906A 27½p 2N2907 30p 2N2923 15p 2N2924 15p 2N2925 15p OC207 OCP71 ORP12 ORP61 P346A 2N5309 2N5310 2N5354 621p 421p 271p 271p 321p 471p 321p 571p 571p 75p 22.00 BC115 BC116A 15p 10p 20p 20p 20p 20p 20p 20p 10p 10p 12p BC118 BFY26 BFY29 BFY30 BFY43 BFY43 BFY43 BFY51 BFY55 BFY55 BFY56 BFY76 BFY77 BFY76 BFY77 BC118 BC121 BC122 BC125 BC126 BC140 BC147 BC148 BC149 2N5354 2N5355 2N5356 2N5365 2N5366 2N5367 2N5367 NKT213 30p NKT214 22½p NKT215 22½p NKT216 37½p NKT216 37½p NKT219 30p NKT223 27½p NKT224 25p NKT225 22½p NKT229 30p NKT227 35p TIS34 TIS43 TIS44 TIS44 TIS45 TIS46 TIS47 TIS48 TIS49 TIS50 TIS51 TIS52

RETURN OF POST SERVICE

	TTL	. LC	GIC I.C	. N	IEW	PRICES	5	
	1-11 1	2-24	. :	1-11 :	12-24			12-24
	£p	£p		£p	£p		£p	£p
SN7400	0.50	0.18	SN7433	0.80	0.75	SN7472	0.32	0.30
SN7401	0.20	0.18	SN7437	0.64	0.06	SN7473	0.43	0.41
SN7402	0.20	0.18	SN7438	0.64	0.60	SN7474	0.43	0.41
SN7403	0.20	0.18	SN7440	0.23	0.21	SN7475	0.45	0.44
SN7405	0.20	0.18	SN7441AN	0.87	0.83	SN7476	0.45	0.44
SN7406	0.80	0.75	SN7442	0.85	0.81	SN7480	0.70	0.65
SN7407	0.80	0.75	SN7443	2.86	2.70	SN7481	1.40	1.38
SN7408	0.20	0.18	SN7444	2.86	2.70	SN7482	0.87	0.82
SN7409	0.20	0.18	SN7445	2.50	2.40	SN7483	0.87	0.82
SN7410	0.20	0.18	SN7446	1.00	0.95	SN7484	2.00	1.8
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SN7420	0.20	0.18	SN7450	0.20	0.18	SN7491AN		1.10
SN7423	0.51	0.47	SN7451	0.20	0.18	SN7492	0.87	0.84
SN7423	0.48	0.45	SN7451	0.20	0.18	SN7493	0.87	0.84
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SA.			25p	30p	321p	35p		·	
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IN4007	20p	AAZ15	12p	BAY38	25p	OA9	10p
1844	7p	AAZ17	10p	BY100	15p	OA47	8p
ISI13	15p	BA100	15p	BY103	22p	OA70	7p
18120	12p	BA102	25p	BY122	471p	OA73	10p
18121	14p	BA110	25p	BY124	15p	OA79	7p
IS130	8p	BA114	15p	BY126	15p	OA81	8r
IS131	10p	BA115	7p	BY127	17p	OA85	10p
IS132	12p	BA141	17p	BY164	57p	OA90	7p
18920	7p	BA142	17p	BYX10	22 p	OA91	7p
18922	8p	BA144	12p	BYZ10	35p	OA95	7p
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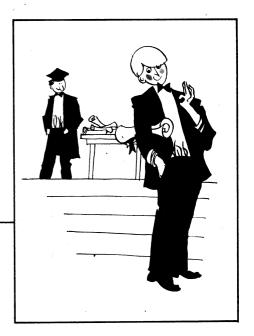
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Last month we posed some problems under the heading Teach in Half-Term Test. We will now answer those problems and try to show how we arrived at the answers. If you have got some of them wrong do not worry, just try and follow our explanation and see where you went wrong.

(1) They flow from negative to positive in reality. Although we assume that conventional current flows from positive to negative the actual electrons flow from negative to positive.

- (2) (b) μ A (microamps), (e) A (amps) (3) 22 volts. V = IR hence V = 0.01 \times 2.2 \times 1,000 = 22V (4) It does not matter. All the resistor does is to limit the current; this can be done at any point around the circuit.

the circuit. (5) 2-8mA. Total resistance is $2\cdot 2k\Omega+1k\Omega=3\cdot 2k\Omega$. Current flow I = $\frac{V}{R}=\frac{9}{3\cdot 2\times 1,000}=2\cdot 8-1,000$ A= $2\cdot 8m$ A (6) R1 and R3 $\frac{1}{2}$ W, R2 1W. Total circuit resistance $R_T=R1+\frac{R2\times R3}{R2+R3}=10+33\cdot 3=43\cdot 3\Omega.$ Total current I = $\frac{V}{R}=\frac{9}{43\cdot 3}=0\cdot 21$ A Dissipation of R1 = I²R = 0·21 × 0·21 × 10 = 0·44W. The nearest commercial rating is $\frac{1}{2}$ W. Next calculate the voltage drop across R2 and R3 together V = IR = 0·21 × 33·3 = 7V. 33.3 = 7V.

We know that $W=I^2R$, but $I=\frac{V}{R}$ therefore

$$W = \frac{V}{R} \times \frac{V}{R} \times R$$
 and, cancelling $W = \frac{V^2}{R}$

Dissipation in R2 =
$$\frac{V^2}{R} = \frac{7 \times 7}{50} = \frac{49}{50} = 0.98W$$

Dissipation in R3 = $\frac{V^2}{R} = \frac{49}{100} = 0.49W$

Dissipation in R3 =
$$\frac{V^2}{R} = \frac{49}{100} = 0.49W$$

(7) 0.4W or 400mW. Maximum dissipation occurs when the value of VR1 equals that of R1 i.e. 50Ω . When both resistors are of equal value the voltage drop across each is half the voltage drop across both, therefore, maximum dissipation in VR1 $= \frac{V^2}{R} = \frac{4.5 \times 4.5}{50} = \frac{20.25}{50} = 0.405W$

$$= \frac{V^2}{R} = \frac{4.5 \times 4.5}{50} = \frac{20.25}{50} = 0.405W$$

- (8) (a) $4.7k\Omega \pm 10\%$
 - (b) $22k\Omega \pm 5\%$
 - (c) $100k\Omega \pm 10\%$

(9) (b) $20\mu F$ 40V. In most applications using electrolytic capacitors the capacitance must be greater than a certain value; the tolerance of a normal 16µF would encompass 20µF. The important thing is that the working voltage is the same or greater.

(10) Reject it politely. He has given you a 120,000pF or 0·12μF capacitor. Check to see if he has the precise value and, if he does not, you may as well take this one, since it should be near enough to use as a substitute.

- (11) C1 will charge up the fastest as it has the lowest value and is being charged through the lowest value resistor.
- (12) C2 will take the longest time to charge, as it has the highest value and is being charged through the highest value resistor.

(13) Forward biassed. The conventional current flows from positive to negative and can thus flow through

the diode in the direction of the arrow.

(14) 100V and 100mA. Peak reverse breakdown voltage will be the battery voltage. Since in the reversed biassed condition there is negligible current flowing R1 will not drop any voltage and the full supply voltage will appear across D1. In the forward biassed condition the diode can be assumed to be a short circuit thus only R1 can limit the current flowing hence

$$I = \frac{V}{R} = \frac{100}{1 \times 1,000} = 0.1A \text{ or } 100\text{mA}$$

(15) (d) 100V, 150mA. Both ratings given are minimum ratings, 0.1A = 100mA.

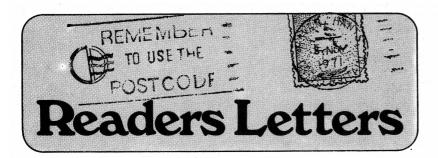
(16) (b) 0.6V. As the diode is forward biassed the voltage would be 0.6V. There is always a voltage drop of approximately 600mV across silicon diodes due to the "knee" in the characteristic.

Well, how did you fare? If you got them all right that is excellent, if you did not the important thing is that you understand where you had difficulties. We suggest that you re-read the relevant sections of the Teach-In series.

We hope that you found the questions a challenge and at the same time they have opened your eyes to some calculation methods-particularly the calculation of dis-

sipation. If you used $W = I^2R$ instead of deriving $W = \frac{V}{R}$

this does not matter but it may pay to look for an easier way next time.



Bias Value

Having been a subscriber to *P.E.* and *P.W.* "off and on" for about 10 years I came across the January issue of EVERYDAY ELECTRONICS, which had my instant approval and now joins the rank of my other magazine's culminating in an endless and very informative pile on top the piano.

I find it is a magazine not only of theoretical enthusiasm but of great practical interest to the "everyday handyman" and certain to be a book for beginners, especially the very helpful facts "projected" by Mike Hughes, M.A.

I would hope in the future that perhaps Mr. Hughes could give reference to finding values of bias resistors, etc., needed for the satisfactory operation of different transistor parameters, and also relevant circuit operation of thyristors, unijunction and field effect transistors and other very useful flexible types of semiconductors.

Noticing other readers' troubles referring to the *Electro Laugh*, I also constructed this article and it worked first time owing to the way I adopt when working on, or constructing any project, I always check the finished article with the actual circuit diagram thus finding our little friend Q7 and P7.

Unfortunately the only earphone I had was a high impedance crystal type, but by connecting a resistor in the region of 250 ohms in parallel with it, it brought the overall impedance down to a satisfactory level with a slight reduction in volume.

J. Mason S. Wales

We doubt if Teach-In will be able to meet all your needs as it will finish after 12 months. However we will be publishing further series that should help.

Another Bug

Naturally, I was quite flattered to discover that you had found my letter sufficiently interesting for inclusion in *Readers Letters* (March issue), however, I must admit that my pleasure was mixed with large helpings of disappointment and frustration due to your editing of the letter.

I am not complaining at all about the amount of space allocated to my comments—I realise you have the right to include only that which in your wisdom you decide is worthy of publication.

My complaint is that you have entirely neglected to make even a brief reference to what was after all the main point of my letter-the difficulty of obtaining items advertised in your magazine. By omitting any reference to this frustrating situation, my letter as printed is sailing under false colours-the few minor constructional queries were in fact, sorted out by trial and error once I got going. The real reason for being unable to get cracking was not so much mounting components, as actually getting hold of them!

The fact that you completely ignored my comments regarding suppliers leads me to two conclusions:

(One) That you accepted my comments to be an exaggeration of a somewhat hysterical nature, and were not a true picture of the real situation, or

(Two) That you accepted my statements as correct, but did not wish to offend your advertisers whose business you must obviously wish to retain.

With regard to the former, I feel I, must now justify my remarks by quoting a few of the more deplorable examples of SERVICE, and leave you to form your own conclusions. These examples are on a separate sheet herewith enclosed.

Regarding (Two), whilst I

realise that you are not to be held responsible for goods or advertised your services in columns, you do, however, have a moral responsibility to your readers. After all, it is you that place these offers before us, the readers, and if for example, I had not seen a certain item offered in your magazine, then I would have been saved the trouble and frustration that followed when the item failed to arrive, and all attempts to obtain satisfaction are largely ignored.

However, I have now found a couple of very good suppliers whose friendly, courteous, and extremely efficient service have allowed me to obtain some of the pleasure that I had hoped would be derived from my new hobby (Galleon Trading Co. and Radio Exchange Co.).

To date I have completed several very efficient radios, some from kits; also the *Astron*, a general purpose amplifier, and one or two other gadgets, and success rate so far is quite satisfactory, so the situation is not too black after all.

J. G. Richards Sale, Cheshire

The above correspondent supplied us with details of orders placed with four different advertisers, none of which had been expediently dealt with, at the time of writing.

We have investigated all of these cases on behalf of our reader. The delays, regrettable as they are, seem to be unavoidable and can be largely attributed to the phenomenal success of this magazine's declared intention to popularise the hobby of electronics!

As a consequence, our advertisers are sometimes overwhelmed by a flood of orders, and delays do therefore sometimes arise. But we know all our advertisers make determined efforts to clear their back-log of orders as quickly as possible.

We, on our part, will always investigate any serious and reasonable complaints, on behalf of our readers.

Cell Life

I have just read the March issue of EVERYDAY ELECTRONICS and thoroughly appreciated the Ruminations by Sensor where he mentioned the tin saw and how much damage could result to a

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post and ins.

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Model 772-small but powerful 1' pull-approx. size
1½' x 1½' x 1½'. 60p.

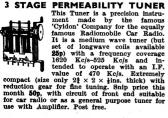
Model 400/1 ½' pull. Size
2½' x 2½' x 1½'. 75p.

Model TT10 1½' pull. Size 3' x 2½' x 2½'. £1-80
plus 20p post and insurance.

4 TELESCOPIC AERIAL

for portable, car radio or transmitter. Chrome plated—
six sections, extends from 7½ to
47in. Hole in bottom for 6BA screw.
38p. KNUCKLED MODEL FOR F.M. 50p.

3 STAGE PERMEABILITY TUNER



CAPACITOR DISCHARGE CAR IGNITION

This system which has proved to be amazingly efficient. We offer kit of parts as PW circuit 25-95 plus 20p p. & p. De-luxe model with prepared circuit board 25-95. When ordering please state whether for positive or negative systems.

RADIO STETHOSCOPE

EASION STETHOSCOPE
Easiest way to fault find—traces signal from aerial
to speaker—when signal stops you've found the
fault. Use it on Radio, TV,
amplifier, anything—complete kit comprises two special
transistors and all parts including probe tube and crystal
earpiece. 42—twin stethoset instead of earpiece 75p
extra post and ins. 20p.



STANDARD WAFER SWITCHES

Standard size 11 wafer—silver-plated 5-amp contact, standard ?" spindle 2" long-with locking washer and nut. y 5 way 6 way 8 way 9 way 10 way 12 way
40p 40p 40p 40p 40p 40p 40p
40p 40p 40p 40p 50p 50p
40p 70p 70p 70p 11.20 11.20
70p 95p 95p 95p 11.20 11.20
95p 11.20 11.20
95p 11.20 11.20 11.20
95p 11.20 11.20
95p 11.20 11.20 11.20
95p 11.20 No. of Poles $2 \hspace{0.1cm} \mathtt{way} \hspace{0.1cm} 3 \hspace{0.1cm} \mathtt{way} \hspace{0.1cm} 5 \hspace{0.1cm} \mathtt{way} \hspace{0.1cm} 6 \hspace{0.1cm} \mathtt{way} \hspace{0.1cm} 8 \hspace{0.1cm} \mathtt{way} \hspace{0.1cm} 9 \hspace{0.1cm} \mathtt{way} \hspace{0.1cm} 10 \hspace{0.1cm} \mathtt{way} \hspace{0.1cm} 12 \hspace{0.1cm} \mathtt{way}$ 1 pole 2 poles 3 poles 4 poles 5 poles 6 poles 7 poles 8 poles 9 poles 40p 40p 40p 40p 70p 70p 70p 70p 70p 40p 40p 40p 40p 70p 70p 70p 70p 95p 40p 40p 40p 70p 70p 70p 95p 95p 95p 10 poles 11 poles 12 poles

THYRISTOR LIGHT DIMMER

For any lamp up to 200 watt. Mounted on switch plate to fit in place of standard switch. Virtually no radio interferences. Price \$1.99 plus 20p post and insurance.



THIS MONTHS SNIP

1 HOUR MINUTE TIMER. Made by Smiths complete with control knob and calibrated dial. This month's special bargain at 50p. Useful in the Kitchen, Office and Dark-room etc.

MULLARD AUDIO AMP LIFIER MODULE



Uses 4 transistors, and has an output of 750m W into 8 ohms speakers. Input suitable for crystal mic. or pick-up. 9 volt battery operated. Size 2* long × 1½* wide × 1* high. SPECIAL SNIP PRICE 60p each. 10 for \$5.

POCKET CIRCUIT TESTER

Test continuity for any low resistance circuit, house wiring, car electrics. Test polarity of diodes and rectifiers. Also ideal size for conversion to signal injector (circuit supplied), 30p or 2 for 50p. Post paid.



METAL LOCATOR **AUDIO TONE GENERATOR BEE COUNTER**

To receive details on these kits send s.a.e. for parts list.

MULLARD I.F. MODULE

This is a fully screened intermediate frequency module for amplification and detection of f.m. signals at 10-7MHz and a.m. signals at 470kHz. The first stage is used as an i.f. amplifier for f.m. and a self-oscillating as an 1.1. ampiner for 1.m. and a self oscillating mixer for a.m. operation, in conjunction with an external oscillator coil. 75p each. 10 for £6:75. 100 for £62:50. With connection dia. 10 for £6.75.



4/4/4/4

DISTRIBUTION PANELS

Just what you need for work bench or lab.
4 × 13 amp sockets in metal box to take
standard 13 amp fused plugs and on/off switch with neon warning light. Supplied
complete with 6 feet of fiex cable. Wired up ready to work.



BATTERY CONDITION TESTER

Made by Mallory but suitable for all batteries made by Ever Ready and others, most of which are zinc carbon types but also mercury manganese—nicad—silver oxide and alkaline batteries may be tested. The tester puts a dummy load on the battery and the meter scale indicates the condition depending upon which section the pointer rests. The section reads "replace" "weak" or "good". The tester is complete in its case, size 24" x 2" with leads and prods. Price \$1.75 plus 20p postage.

Thermostat with Probe. Made by the famous Ranco Thermostat Co. Covers the range from approx. O°-20°0C. variable by a control spindle, handles currents up to 16 amps. Length of capillary and sensor tube approx. 3′ 6″. These are ideal for ovens and as a general purpose thermostat. Price 50p each or 10 for 24·50.

Small Tuning Condenser as fitted to many imported Japanese and Hong Kong radios. 2 gang about 200PF per gang. Size approx. 1′ × 1′ with a ½ diameter spindle with dust cover. 25p each or 10 for 25·25.

Heat Sink. Small type as used with OCS1 etc. Price 5p each or 10 for 45p.

Spectacle Frames. (No lenses) with built-in hearing aids. The amplifier and battery being housed in the arms. Although these are complete hearing aids we are selling them purely for the sub miniature components they contain. We give no guarantee that they are in working order also these may be secondhand. Price 22·50 each.

Foot Switch. Twin levers each of which operates a 10 amp QMB changeover switch. Price 90p each.

From William Contact. The contacts may be set to trigger anywhere around the shaft, ideal for motivated lighting displays, sequential switching cromposition of the contact. Programmers. See the contacts. Price 30 Model Bhas 1 change over contacts. Price 32.

Radiant Cooker Rings. As fitted to Tricity and many other popular cookers. We have two types. These are copper clad ½′ tubular construction. Backer Model 7D1 MkH again 2000 watts rated to increase radiation.

Backer Model 7D1 MkH again 2000 watts rated to increase radiation.

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Backer Model 7D1 McH again 2000 watts rated to increase radiation.

Backer Model 7D1 McH again 2000 watts rated approx. 1′ × ½′ rated 250 v lamp, 6p each. 10 for 54.28.

each. 10 for 24p. 100 for 25·10. 500 less for 224.

As above but for printed circuit 5p each, 10 for 45p, 100 for 24·25.

Sub Ministure Slide Switch. DPDT 19mm (4" approx.) between fixing centres. 12p each or 10 for £1.08.

KITS FOR PREVIOUS PROJECTS

Unless otherwise stated, kits contain electronic parts only. The case and special items can be obtained locally. Also batteries are not included. Kits may be returned for refund if construction has not been started. We reserve the right to substitute compouents should deliveries be protracted so as to avoid undue delay.

HOME SENTINEL INTRUDER ALARM Electronic Components with suitable case 23.75 DEMO DECK \$6.75 POST PAID DEMO DECK 46.75 POST PAID FUZZ BOX 21.85 PHOTOGRAPHIC COLOUR 21.85 TEMPERATURE METER 22.65 ASTRON RADIO 23 REMOTE TEMPERATURE 20 COMPARATOR 24.25 ELECTRO LAUGH 22 TRANSISTOR MICROPHONE 21.70 AUTO ALERT All electroic parts and metal bracket 49.50 All electronic parts and metal bracket £2.50 RAIN WARNING ALARM RAIN WARNING ALARM All electronic parts and chassis \$21.80 WA-WA PEDAL \$29.90 DARKEOOM TIMER \$4.50 SIGNAL INJECTOR \$0 SIGNAL INJECTOR \$20 SIMPLE CALCULATOR \$29.00 DAUGHT \$25.00 DAUGHT \$25.00 BABY ALARM \$4.00

Mains Transformer, Primary 240v. tapped 220v. Secondary 20v. ½ amp. Price 60p each or 10 for 25.40.

for \$5-40.

Dial Thermometer—reading from 200-525F used on Tricity and other cookers. This has a flange and can be mounted through a 1½ hole or alternatively it can just be rested on the object whose temperature it is required to measure. Size 2 × ½ overall diameter. Depth ½ below and ½ above mounting panel. Price 80p each or 10 for \$7.20p.

24-HOUR TIME

24-HOUR TIME SWITCH
Made by Smiths, these are AC mains operated, NOT CLOCKWORK. Ideal for mounting on rack or shelf or can be built into box with 13A socket. 2 completely adjustable time periods per 24 hours, 5 amp change

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AAY42	10p 15p	BD115 75p BD123 85p	OC16 50p OC20 85p OC22 50p OC23 60p	2N1303 18p 2N1304 22p
AAY42 AAZ13	10p	BD124 80p	OC20 85p OC22 50p	2N1304 22p 2N1305 22p
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ACY19	25p	BF158 150	OC70 19n	1 9N79910 90m
ACY20 ACY21	20p 20p	BF159 35p BF180 35p	OC71 12p	
ACY22 ACY39	10p	BF194 15p BF195 15p	OC75 25p	2N2220 25p 2N2221 20p
ACY40	55p 20p	BF196 15p	OC77 40n	2N2221A
ACY41 ACY44	15p i	BF197 15p BFX13 25p	OC81 20p OC81D 20p	25p 2N2222 20p
AD140	25p 50p 50p	BFX29 25p	OC81Z 40p OC83 25p	2N2222A 25p
AD149 AD161	35n	BFX84 25p	IOC84 25 n	2N2369 15p
AD162 AF114	35p 25p	BFX86 25p	OC139 25p OC140 40n	2N2369A 15p
AF115 AF116	2.5n	BFX87 25p BFX88 20p	OC141 60p	2N2646 40p 2N2904 20p
AF117	25p 20p	BFY18 25p	OC170 25p	2N2904A
AF118 AF124	60p 25p	BFY50 20p BFY51 20p	I OC200 40n	25p 2N2905 25p
AF125		BFY52 2Cp	OC202 80 p	2N2905A
AF126 AF127 AF139	20p 20p	BFY90 65p	OC206 95p OCP71 97p ORP12 50p	25p 2N2906 20p
AF139 AF180	50p	BSX20 15p BSX21 20n	ORP12 50p ORP60 40p	2N2906A 25p
AF181	45p	BS 127 13p	ST140 15p	2N2907 23 p
AF185 AF186	40n	BSY95 12p	ST141 20p TIP29A 50p	2N2907A 25p
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BC169C BC177	15p	MJE3055 75p	2G301 25p 2G302 30p	2N4289 12p 2N4290 12n
BC178 BC179	20p	MPSA06 25p	2G303 35p	2N4871 35p
BC182L	20p	MPSA56 20p MPSA70 15p	2N404 20p 2N696 15p	2N5457 30p 2N5458 35p
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403	Quad 2-input open collector NAND gates	20p	18p	16p	14p	12p
404	Hextuple inverters	20p	18p	16p	14p	12p
					14p	12p
405	Hex inverters with open collector outputs	20p	18p	16p		
410	Triple 3-input NAND gates	20p	18p	16p	14p	12p
413	Dual 4-input Schmitt triggers	30p	27p	25p	22p	20p
420	Dual 4-input NAND gates	20p	18p	16p	14p	12p
430	Dual 4-input NAND gates Single 8-input NAND gates Dual 4-input NAND buffer gates BCD-Decimal decoder/Nixle driver	20p	18p	16p	14p	12p
440	Dual 4-input NAND buffer gates	20p	18p	16p	14p	12p
441	BCD-Decimal decoder/Nixle driver	75p	72p	70p	60p	55p
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450	Expand dual 2-input AND-OR-INVERT gates	20p	18p	16p	1 4 p	12p
451	Dual 2-wide 2-input AND-OR-INVERT gates	20p	18p	16p	14p	12p
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454			18p	16p	14p	12p
460	Dual 4-input expanders	20p				
470	Single J-K flip-flop (gated inputs)	80p	27p	25p	22p	20p
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473	Dual J-K flip flop	40p	37p	35p	38p	30p
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495	4-bit up-down shift register	80p	75p	70p	65p	60p
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ZL series 25p 23p 20p 17p 15p 3 watt 3TZ series 30p 27p 25p 22p 20p 10 watt ZS series +40p 37p 35p 30p 25p 10 watt
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5p 4½p 4p
6p 5p 4½p
6p 5p 4½p
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When I read about the Signal Injector by Alan Jardine I was reminded of the poor beginner.

Following the instruction to solder the leads direct on to the cell will result in heating up the electrolyte and a very short life for the cell.

Perhaps this is not important as the choice of a push-on/push-off switch allows no easy means of knowing if the thing is on or off. Very few beginners will remember to test each time, and cell life will be short it is expected. A push button perhaps?

The blind cannot be expected to lead the blind, and beginners are usually short of experience.

R. Quorn Sussex

Of your two points concerning the Signal Injector, the first is a bit exaggerated. It is true that the cell life will be reduced by applying heat (from soldering iron) to the battery terminals but this is only negligible for the time required to execute the connection.

To install a holder to suit this type of battery would increase the cost by about 40 per cent.

We agree that it will be difficult to tell if the unit is on or off when not in use, but it can be determined; when the unit is "on" the push button will feel "loose" but in the "off" position this looseness disappears.

If this proves unsatisfactory a push-to-make release off type can be substituted.

More Accurate Timer

May I thank you for publishing another article combining the hobbies of electronics and photography (ref. *Darkroom Timer*, March issue).

Although of excellent design, I feel it must be stated that a timer with only a 5 second timing intervals is not nearly accurate enough for the demands of the high quality black and white or well balanced colour prints that are required. However, with a small modification, I have found that the timer may be converted to an accurate piece of equipment having a timing range of 5 to 45 seconds in one second steps.

The modification requires four extra components, which are a 5 position two-pole switch (S4), VR5, VR6 and VR7 which are

skeleton presets of the values, 5 kilohm, 10 kilohm and 20 kilohm respectively.

These components form an additional timing circuit which is connected in series with the original (R_t) .

Position 1 of the switch has no further resistance and acts as a short circuit; position 2 connects VR5 into circuit, whilst position 3 connects VR6; position 4 connects VR5 and VR6 and position 5 connects VR7 into circuit.

Each position of the new switch is to represent a further one second delay.

Position 1 of course, has no further delay, position 2 however, will give a one second delay, position 3 two seconds etc. when the presets are set as they were in the original timing circuit.

Now, any time, in one second steps may be selected from 5 to 45 seconds by selecting the required 5 second range, plus the required extra time (if any) on the new switch.

D. G. Smith Emsworth, Hants.

Components

Let me say first of all how much I enjoy your magazine and as a newcomer to electronics I find your *Teach-In* articles very interesting and also *Shop Talk*, etc. However, I wonder if I may make a suggestion?

I constructed your *Demo-Deck* and find that in following this series for a month or so there is a list of the more minor components used in the experiments and I wondered if it would be at all possible, either, preferably, if you could publish the list of all the components that would be required for the rest of this series in one complete list or if possible broken up into the individual months during which they will be required.

The reason I say this is, that I,

like many of your other readers no doubt, have no local supplier of components in my immediate vicinity and it usually means a trip to Edinburgh or Glasgow to purchase these components.

However, if I could have a full list this would make things much easier for me. It would also make it much easier to send off a full list by post to a mail order firm rather than asking for two or three small components every month or so. I wonder if this could be done.

I am very grateful to you and wish you every success for your future publications.

> R. L. Grant Scotland

It was our intention to publish an advanced list and in future we shall be publishing, at the end of each Teach-In every month, a list of components additional to those you have already acquired.

Calling Gloucester

Now that I'm receiving your magazine on regular order and greatly enjoying it, I feel that I ought to go a stage further in order to get any lasting benefit from your guidance.

Can I please find out through your pages how many people in the Gloucester area are willing to ask for, and attend, an evening class on useful, basic "everyday electronics"?

Should anyone be interested, could they please write to me at the address given, then provided enough wish it, our local Education Authority can be approached with evidence that the need for such a class does exist.

Many thanks for giving me a chance to ask for these people through your very sensible magazine.

E. L. Payn 82 Innsworth Lane, Longlevens, Gloucester GL2 0DE

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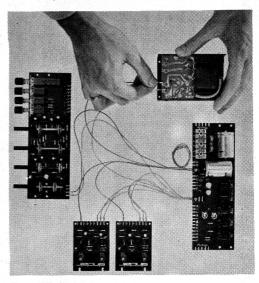
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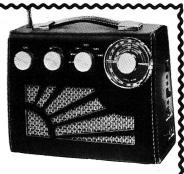
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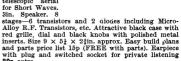
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